JUDICIAL ROOM
ERAL LIBRARY
IV. OF MICH

JUN 2 1930

NATURAL HISTORY

May-June
1930

Price Fifty
Cents

THE WOOLLY MAMMOTH OF THE NORTH

JOURNAL OF THE AMERICAN
MUSEUM OF NATURAL HISTORY

NEW YORK, N. Y

THE AMERICAN MUSEUM OF NATURAL HISTORY

Scientific Staff for 1930

HENRY FAIRFIELD OSBORN, LL.D., President
GEORGE H. SHERWOOD, ED.D., Director and Executive Secretary
JAMES L. CLARK, Assistant Director, Preparation
WAYNE M. FAUNCE, SC.B., Assistant to the Director and Assistant Secretary

I. DIVISION OF MINERALOGY, GEOLOGY, GEOGRAPHY, AND ASTRONOMY

HENRY FAIRFIELD OSBORN, LL.D., D.Sc., Curator-in-Chief

Astronomy

CLYDE FISHER, PH.D., LL.D., Curator

Minerals and Gems

HERBERT P. WHITLOCK, C.E., Curator
GEORGE F. KUNZ, PH.D., Research Associate in Gems

History of the Earth

HENRY FAIRFIELD OSBORN, LL.D., D.Sc., Honorary Curator-in-Chief
CHILDS FRICK, B.S., Honorary Curator of late Tertiary and Quaternary Mammals

Fossil Vertebrates

WALTER GRANGER, Curator of Fossil Mammals
BARNUM BROWN, A.B., Curator of Fossil Reptiles
GEORGE G. SIMPSON, PH.D., Associate Curator of Vertebrate Palæontology
CHARLES C. MOOK, PH.D., Associate Curator of Geology and Palæontology
WILLIAM K. GREGORY, PH.D., Research Associate in Palæontology
WALTER W. HOLMES, Field Associate in Palæontology

Geology and Fossil Invertebrates

CHESTER A. REEDS, PH.D., Curator

II. DIVISION OF ZOÖLOGY, AND ZOÖGEOGRAPHY

FRANK MICHLER CHAPMAN, SC.D., N.A.S., Curator-in-Chief

Marine Life

ROY WALDO MINER, PH.D., SC.D., Curator
WILLARD G. VAN NAME, PH.D., Associate Curator
FRANK J. MYERS, Research Associate in Rotifera
HORACE W. STUNKARD, PH.D., Research Associate in Parasitology
A. L. TREADWELL, PH.D., Research Associate in Annulata

Insect Life

FRANK E. LUTZ, PH.D., Curator
A. J. MUTCHLER, Associate Curator of Coleoptera
C. H. CURRAN, M.A., Assistant Curator
FRANK E. WATSON, B.S., Staff Assistant in Lepidoptera
WILLIAM M. WHEELER, PH.D., Research Associate in Social Insects
CHARLES W. LENG, B.S., Research Associate in Coleoptera
HERBERT F. SCHWARZ, A.M., Research Associate in Hymenoptera

Fishes

WILLIAM K. GREGORY, PH.D., Curator
JOHN T. NICHOLS, A.B., Curator of Recent Fishes
E. W. GUDGER, PH.D., Bibliographer and Associate

Fishes (continued)

FRANCESCA R. LAMONTE, A.B., Assistant Curator
CHARLES H. TOWNSEND, SC.D., Research Associate
C. M. BREDER, JR., Research Associate
VAN CAMPEN HEILNER, M.Sc., Field Representative
LOUIS HUSSAKOF, PH.D., Research Associate in Devonian Fishes

Amphibians and Reptiles, and Experimental Biology

G. KINGSLEY NOBLE, PH.D., Curator
CLIFFORD H. POPE, B.A., Assistant Curator
CHARLES E. BURT, M.S., Assistant Curator
BERTRAM G. SMITH, PH.D., Research Associate
WILLIAM DOUGLAS BURDEN, A.M., Research Associate
FRANK S. MATHEWS, M.D., Research Associate
HOMER W. SMITH, SC.D., Research Associate
O. M. HELFF, PH.D., Research Associate

Birds

FRANK M. CHAPMAN, SC.D., Curator-in-Chief
ROBERT CUSHMAN MURPHY, D.Sc., Curator of Oceanic Birds
JAMES P. CHAPIN, PH.D., Associate Curator of Birds of the Eastern Hemisphere
JOHN T. ZIMMER, B.S., M.A., Associate Curator of Birds of the Western Hemisphere
ELSIE M. B. NAUMBURG, Research Associate

Mammals of the World

H. E. ANTHONY, M.A., Curator
ROBERT T. HATT, A.M., Assistant Curator
GEORGE G. GOODWIN, Assistant Curator
WILLIAM J. MORDEN, PH.B., Field Associate

Comparative and Human Anatomy

WILLIAM K. GREGORY, PH.D., Curator
H. C. RAVEN, Associate Curator
S. H. CHUBB, Associate Curator
MARCELLE ROIGNEAU, Staff Assistant
J. HOWARD MCGREGOR, PH.D., Research Associate in Human Anatomy
DUDLEY J. MORTON, M.D., Research Associate

III. DIVISION OF ANTHROPOLOGY

CLARK WISSLER, PH.D., LL.D., Curator-in-Chief

Science of Man

CLARK WISSLER, PH.D., LL.D., Curator-in-Chief
N. C. NELSON, M.L., Curator of Prehistoric Archæology
GEORGE C. VAILLANT, PH.D., Associate Curator of Mexican Archæology
HARRY L. SHAPIRO, PH.D., Assistant Curator of Physical Anthropology
MARGARET MEAD, PH.D., Assistant Curator of Ethnology

Science of Man (continued)

RONALD L. OLSON, PH.D., Assistant Curator of South American Archæology
WILLIAM K. GREGORY, PH.D., Associate in Physical Anthropology
CLARENCE L. HAY, A.M., Research Associate in Mexican and Central American Archæology
MILO HELLMAN, D.D.S., Research Associate in Physical Anthropology
GEORGE E. BREWER, M.D., Research Associate in Somatic Anthropology

IV. DIVISION OF ASIATIC EXPLORATION AND RESEARCH

ROY CHAPMAN ANDREWS, SC.D., Curator-in-Chief
WALTER GRANGER, Curator in Palæontology
CHARLES P. BERKEY, PH.D., [Columbia University], Research Associate in Geology
AMADEUS W. GRABAU, S.D., [Geological Survey of China], Research Associate

V. DIVISION OF EDUCATION AND PUBLICATION

GEORGE H. SHERWOOD, ED.D., Curator-in-Chief

Library and Publications

IDA RICHARDSON HOOD, A.B., Acting Curator
HAZEL GAY, Assistant Librarian
JANNETTE MAY LUCAS, B.S., Assistant Librarian—Osborn Library

Education and Public Health

GEORGE H. SHERWOOD, ED.D., Curator-in-Chief
CLYDE FISHER, PH.D., LL.D., Curator of Visual Instruction
GRACE FISHER RAMSEY, Associate Curator
WILLIAM H. CARR, Assistant Curator
NANCY TRUE, A.B., Staff Assistant
ELIZABETH A. ECKELS, PH.B., Staff Assistant
PAUL B. MANN, A.M., Associate in Education
FRANK E. LUTZ, PH.D., Research Associate in Outdoor Education

---

CHARLES-EDWARD AMORY WINSLOW, D.P.H., Honorary Curator of Public Health

---

Printing and Publishing

HAWTHORNE DANIEL, Curator, Editor of *Natural History*
A. KATHERINE BERGER, Associate Editor of *Natural History*
ETHEL J. TIMONIER, Associate Editor of Scientific Publications

Public Information

GEORGE N. PINDAR, Chairman
GEORGE H. SHERWOOD, A.M., ED.D.
WILLIAM K. GREGORY, PH.D.
WAYNE M. FAUNCE, SC.B.
CLARK WISSLER, PH.D.
HAWTHORNE DANIEL

Advisory Committee on Natural History Magazine

HAWTHORNE DANIEL, Chairman

HENRY FAIRFIELD OSBORN, LL.D., D. Sc.
CLARK WISSLER, PH.D., LL.D.
GEORGE N. PINDAR
FRANK M. CHAPMAN, SC.D.
FRANK E. LUTZ, PH.D.
GEORGE H. SHERWOOD, ED.D., *ex-officio*
A. KATHERINE BERGER

VOLUME XXX
NUMBER 3

NATURAL HISTORY

MAY-JUNE
1930

The Journal of The American Museum of Natural History

HAWTHORNE DANIEL
Editor

A. KATHERINE BERGER
Associate Editor

CONTENTS

THE WOOLLY MAMMOTH OF THE NORTH ..... *Cover*
From a Painting by Arthur A. Jansson. See Page 338

THE WOOLLY MAMMOTH PIT OF MORAVIA ..... *Frontispiece*
From a Painting by E. Rungius Fulda

THE ROMANCE OF THE WOOLLY MAMMOTH ..... HENRY FAIRFIELD OSBORN 227
The First Extinct Mammal To Be Found by Man

THE NEW PLANET—A DRAMATIC DISCOVERY ..... CLYDE FISHER 242
The Most Recent Triumph of Scientific Investigation

THE DISAPPEARING PEOPLES OF THE SOUTH SEAS ..... H. L. SHAPIRO 253
The Influence of Europeans on the Peoples of Polynesia

"TOP OF THE WORLD" IN YUCATAN ..... MARCELLE ROIGNEAU 267
Digging for Fossil Mammals in the Land of the Maya

CADDIS FLIES AS MASONS AND BUILDERS ..... FRANK E. LUTZ 276
Flexibility in the Case-Making Behavior of the Caddis-Fly Larvæ

THE ART OF THE NORTHWEST COAST INDIAN ..... LIEUT. G. T. EMMONS 282
How Ancestral Records Were Preserved in Carvings and Paintings of Animal Figures

THE MOUND BUILDERS ..... H. C. SHETRONE 293
The Pick and Shovel of the Archæologist Reveal American Prehistory

RODENT GIANTS ..... GEORGE GAYLORD SIMPSON 305
Living Gnawing Animals from Tiny Mice to Giant Capybaras

MUSEUM GROUPS AND THE ACCESSORY MAN ..... ALBERT E. BUTLER 314
How the Setting for a Museum Group is Collected and Prepared

AMERICAN MUSEUM EXPEDITIONS AND NOTES 323

Published bimonthly by The American Museum of Natural History, New York, N. Y. Subscription price $3.00 a year.

Subscriptions should be addressed to James H. Perkins, Treasurer, American Museum of Natural History, 77th St. and Central Park West, New York, N. Y.

NATURAL HISTORY *is sent to all members of the American Museum as one of the privileges of membership.*

Entered as second-class matter April 3, 1919, at the Post Office at New York, New York, under the Act of August 24, 1912.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 15, 1918.

Copyright, 1930, by The American Museum of Natural History, New York

Drawn by E. Rungius Fulda

THE WOOLLY MAMMOTH PIT OF MORAVIA

Aurignacian hunters in the act of killing a bull mammoth by hurling giant stones upon him
After the discoveries and studies of Dr. Carl Absolon of the University of Prague, with acknowledgments to A. Forestier and The London Illustrated News

—See "The Romance of the Woolly Mammoth," Page 227

VOLUME XXX

NATURAL HISTORY

NUMBER THREE

MAY-JUNE, 1930

THE ROMANCE OF THE WOOLLY MAMMOTH

The First Extinct Mammal to be Found by Man—The Million-Year Quest for Ivory —Fidelity and Accuracy of the Aurignacian and Magdelenian Artists—Aurignacian Mammoth Hunters of Moravia—Eastward Migration of the Woolly Mammoth to North America

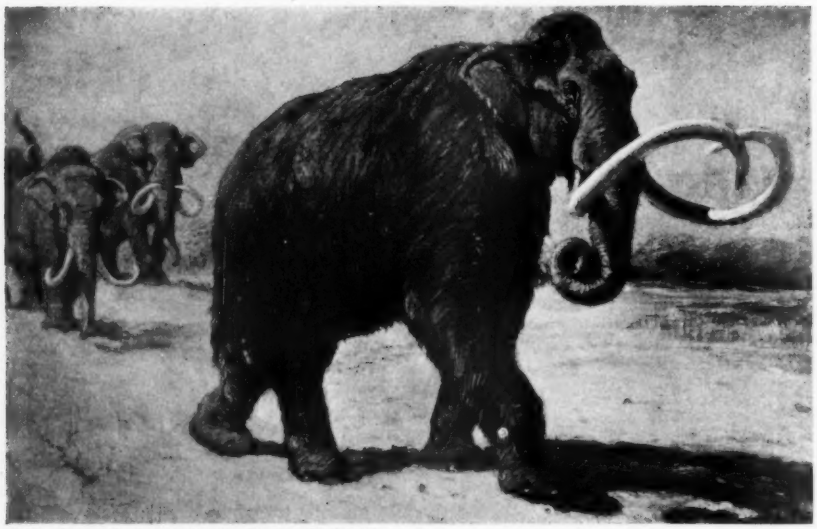
By HENRY FAIRFIELD OSBORN

Honorary Curator, Department of Vertebrate Palæontology, American Museum

Since 1907, when the American Museum sent an expedition into the northern fringe of the Libyan Desert bordering the richly fertile Fayûm area of northern Egypt, the author of the following article has been continuously engaged in studying the lineage of the mastodon and elephant family in all its branches. In 1900 the author had predicted that it would be found that the Proboscidea originated in Africa; this prediction was fulfilled in 1901 by British discoveries, and in 1907 the author, accompanied by Walter Granger, led the American Museum expedition which yielded a rich collection of primitive mastodonts. Africa is now definitely proved to be the homeland from which no less than fourteen different branches of mastodonts and elephants spread northward to populate the whole world except Australia. 'The farthest north' was reached by only the Woolly Mammoth, whose romantic habits of life and migrations are described in the present article.—The Editors.

THE woolly mammoth is the classic of palæontology; it is the first extinct mammal to be found by man; it is the first to be used as proof of a universal deluge; it is the first to be used as proof of the existence of a long extinct world of mammalian life antecedent to the deluge; it is the first to receive a scientific description in the Latin language; it is the first to receive a scientific name—*Elephas primigenius* or 'the first of all, or original, elephant.' It took nearly two centuries thus to baptize the woolly mammoth as the honored primate of the fossil mammalian world and to usher in the elaborate and intricate science of mammalian palæontology through which we now decipher the prehistory of the earth for the past thirty million years almost as clearly as if we were able to project ourselves back into these long corridors of time.

The romance of the woolly mammoth stretches back for thousands—perhaps for hundreds of thousands—of years to the time when the men of the Old Stone Age discovered that the ivory of the tusk of the mammoth and of other elephants was superior to bone for several utilitarian purposes, as well as for the expression of man's



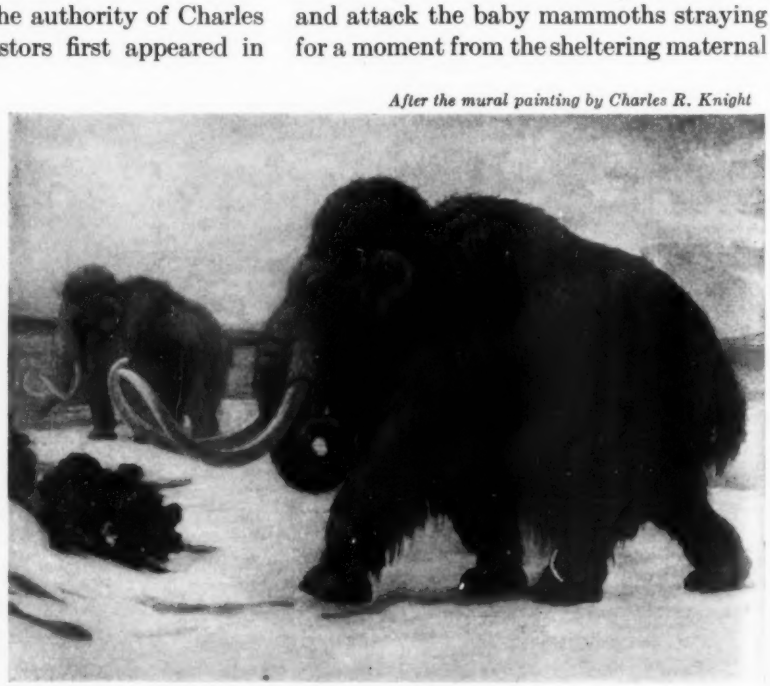
The Jeffersonian mammoth was probably hairy, with a fine undercoating of wool in the winter season. Its tusks are incurved exactly as in the remotely related woolly and imperial species. Its concave forehead is quite distinct from that of the modern elephant. As found in Indiana, it measured 10½ feet at the shoulder

After the original painting by Charles R. Knight

JEFFERSONIAN MAMMOTH OF INDIANA

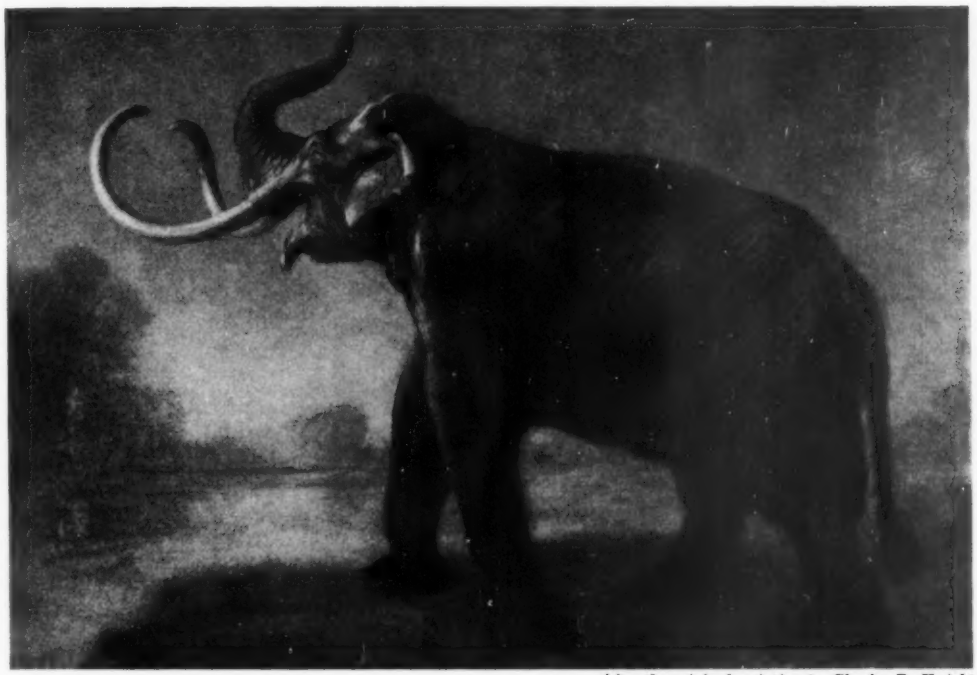
sculptural instinct. Thus the ivory tusks of the three mammoths depicted on the cover of NATURAL HISTORY by Mr. Arthur A. Jansson are appropriately designed as an introduction to a recital of this romance. At all times, from the very beginning of the Age of Man or close of the Pliocene period when, on the authority of Charles Depéret, its ancestors first appeared in the warm forests of Italy, the woolly mammoth has kept its beautiful, brightly shining tusks sharpened at the tips, both for prowess in combat for the mastery of the female herd, and to further the efforts of the young mothers to ward off the many enemies that might surround and attack the baby mammoths straying for a moment from the sheltering maternal

After the mural painting by Charles R. Knight



WOOLLY MAMMOTH, SOMME RIVER, FRANCE

This mammoth is a little more than 9 feet at the shoulder, whereas the Jeffersonian mammoth is 10½ feet and the imperial mammoth 13 feet. The painting closely follows the drawings in the cavern of Combarelles (p. 241). The rapidly sloping hind quarters of the animal serve as a water-shed for rain and sleet



After the original painting by Charles R. Knight

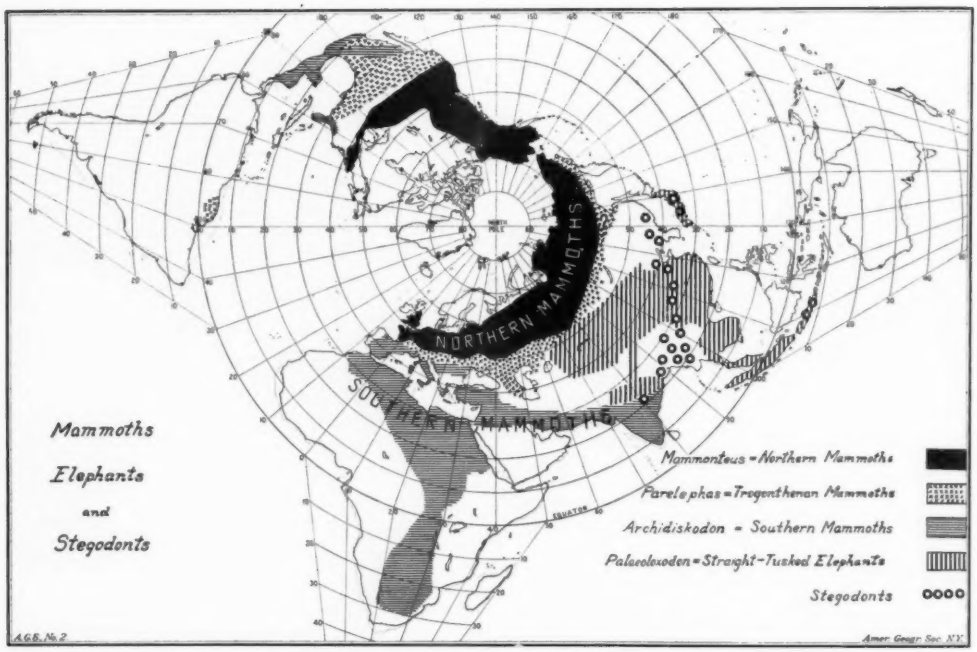
IMPERIAL MAMMOTH OF NEBRASKA

This superb animal, first named *Elephas imperator* by Leidy, stands fully 13 feet at the shoulder—4 feet taller than the woolly mammoth but with similar curved tusks and sloping hind quarters. The best skeleton is in the Nebraska State Museum (*Archidiskodon imperator maibeni*); the finest cranium is in the zoological museum of the City of Mexico. The animal ranged from Nebraska to Mexico. Like the Indian elephant, it probably had little hair and no wool

side. It is only when the old bull mammoths retire from their paternal duties to a quiet, bucolic life on the northern tundras that the ivory tusks begin to curl inward, even to the crossing point, thus rendering them useless both for purposes of combat and for herd protection. This is true also of the Jeffersonian and the imperial mammoths of North America.

Similar tusks glisten today in the African and Indian elephant, their beautiful 'ivory-white' contrasting with the somber gray sides of these animals, just as during the million-year Stone Age they contrasted with the hairy and woolly covering of the mammoth of the North.

Upon observation, however, a very important difference between all the mammoths and the living elephants is revealed in the curvature and uses of the tusks, namely, that the tusks of the mammoth, while emerging from the upper jaw closely side by side, soon begin to spread apart and then, slowly rotating on their axes, turn inwards toward each other to finally form a huge ivory circle with tips actually crossing. It was to this great wheel-like circle that one of the first authorities applied the name *Dicyclotherium*. A similar ivory circle around the large proboscis is also observed in two other extinct elephants to which for this and other reasons the name 'mammoth' may be applied: these are the Jeffersonian mammoth, *Parelephas jeffersonii*, probably a hairy type lacking the heavy undercoating of wool of its northern relative, which roamed from the north temperate region to about N. Lat. 40° over France through Germany to the United States; also the imperial mammoth, *Archidiskodon imperator*, probably hairless, with



GEOGRAPHIC DISTRIBUTION OF MAMMOTHS IN UPPER PLIOCENE AND PLEISTOCENE TIMES

Relatives of the southern imperial mammoth, *Archidiskodon imperator*, are now known to have ranged from South Africa to India and from Nebraska to Mexico. The temperate Trogontherian and Jeffersonian mammoths of the genus *Parelephas* ranged along the 40th parallel from southern France to central United States. The northern mammoth, of the genus *Mammonteus*, ranged about the Arctic Circle from western Europe to eastern North America

great incurved ivory tusks that attained a gigantic size in its antecedents of the more southerly latitudes of Europe and Asia. As shown on the map above, these three mammoths—the 'woolly,' the 'Jeffersonian,' the 'imperial'—formed three great mammoth belts around the Northern Hemisphere which were as sharply demarcated as are the reindeer, the moose, and the stag, or wapiti, belts today.

We know that Stone Age man hunted the bone of the elephant and mastodon for a million years, for we find that the Piltdown Man of Upper Tertiary time fashioned one of the long bones of the mastodon for a tool; it is not improbable that he tried to fashion the ivory tusks as well, although we have no proof of this until ivory carvings are discovered toward the close of the Old Stone Age. Certainly ivory has been treasured by man for thousands of years. Primitive traders carried ivory from point to point. It is not surprising, therefore, that man knew about ivory long before he knew about its source. Thus, again, in the early and wide-spread quest of ivory by man for utilitarian and artistic purposes it is not surprising that the word 'ivory' is the actual source of the scientific name *Elephas*, a Greek term of vague linguistic origin, subsequently Latinized. Homer used this Greek term not in reference to the elephant itself but to its tusks or 'ivory.' With both Homer and Hesiod the word *Elephas* means ivory. Aristotle (384–322 B.C.) in his *History of Animals*[1] used ἐλέφας in its modern generic sense as applying to the elephant

[1]Translation by Richard Cresswell, London, 1887, p. 234.

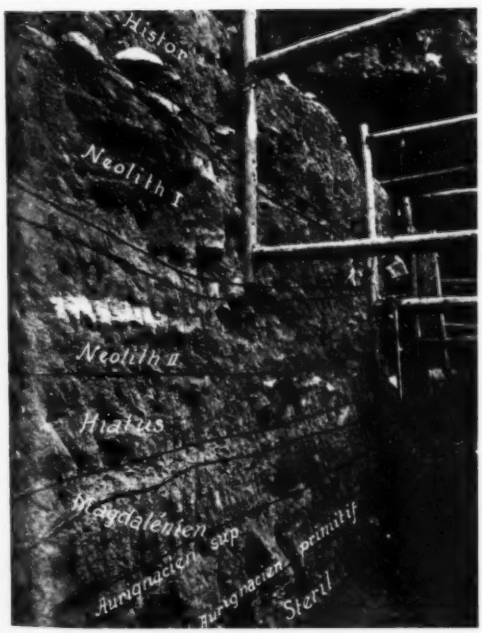
of India, in referring to its courage in combat:

> . . . Elephants also fight fiercely with each other, and strike with their tusks; the conquered submits entirely, and cannot endure the voice of the victor: and elephants differ much in the courage they exhibit.

The word 'mammoth' has a similar non-classic and indirect origin. In allusion to the fact that the Tatars of Siberia first discovered the ivory tusks by digging in the earth, the word 'mammoth' is probably derived from the alleged Tatar word *mamma*, signifying 'earth.' As early as 1696 this was combined with another Tatar word *kost*, signifying 'ivory,' and the two words were Latinized by Ludloff into *Mammontova Kost*. The buried tusks were sometimes mistaken for horns; Cuvier alludes to these words of Tatar origin as follows: "C'est sous le

THE MAMMOTH PIT OF VĚSTONICE, MORAVIA

Beneath the loess-covered limestone hills of Věstonice was discovered this station, more than 130 square metres in extent. Here three heaps of mammoth tusks were piled in orderly fashion by Lower Aurignacian hunters. (After photograph by Doctor Absolon)

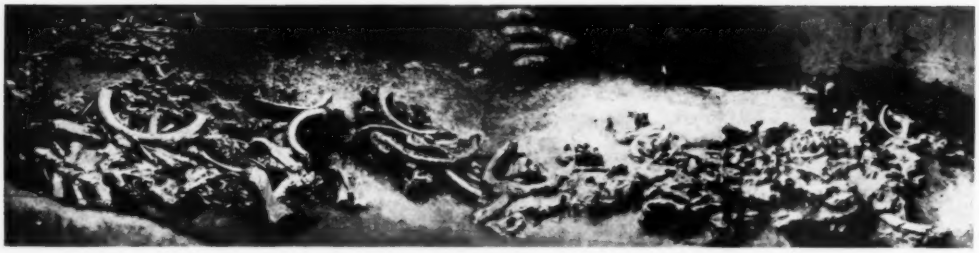


STRATA OF THE PEKÁRNA CAVE, MORAVIA

New and Old Stone Age strata, from historic time downward to Lower Aurignacian—altogether ten distinct layers, representing a period which Doctor Absolon believes extended over 100,000 years. The mammoth layer is contemporaneous with the Lower Aurignacian. (After photograph by Doctor Absolon)

nom de *cornes de mammont, mammontova-kost*, qu'ils désignent les défenses." Thus in the Latinization of the Tatar word *mamma* into the Gallic *mammont* there was assigned by Camper in 1788 the name *Mammonteus*, which is now applied by Osborn to the woolly mammoth as a genus distinguished in many external and internal characters from the genus *Elephas* which is typified by the elephant of India.

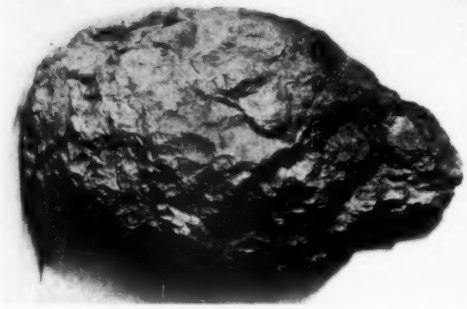
Thus apparently originated the word 'mammoth,' variously spelled in different languages *mammot*, *mamant* (Russian), *mammouth* (French), *mammuth* (German), from the Tatar *mamma* because the remains of these animals were found imbedded in the earth, the natives therefore believing that the animals burrowed like moles. Undoubtedly the woolly mammoth was in its time the colossus of living mammals of northern or western Europe; in consequence the word 'mammoth' has become a con-



(*Above*)

THE MAMMOTH PIT OF VĚSTONICE, MORAVIA

Another view of the mammoth pit of Věstonice shown on page 231. Mammoth skeletons are strewn over the floor. (Photograph by Doctor Absolon)



After Photograph by Doctor Absolon

(*Left*)

GIANT KILLING STONE OF THE MORAVIAN HUNTERS

Doctor Absolon interprets the large stones found in the cave as the weapons with which the mammoths were killed after being trapped. (See frontispiece)

venient adjective to signify gigantic, immense, of great comparative size. As a matter of fact, the woolly mammoth is a dwarf in comparison with its relatives, the Jeffersonian and imperial elephants, as is shown in the illustrations by Knight which have been brought to uniform scale for the present article (Pages 228 and 229).

Long before the elephant was known in Europe, Phœnician traders brought ivory from the South to Greece; in the North it was also procured in the tusks, the average weight of which was 288 pounds, of the more or less fresh or partly frozen bodies of the woolly mammoths. This northern source of the primitive ivory trade has been thoroughly studied in recent years by Basset Digby (1926), Pfizenmayer (1926), and Tolmachoff (1929), and also summarized by Herbert Lang (1925). In Tolmachoff's recent and comprehensive memoir[1] is found a map (Page 234) and a list of not less than thirty-nine localities where frozen carcasses have been found, beginning with Ysbrand Ydes (1692) and ending with Andrews' discovery of 1923. The author gives due credit to the works of Basset Digby and of Pfizenmayer. He also gives a most detailed and interesting history of the progress of discovery of the woolly mammoth, *Elephas primigenius*, and of its woolly companion, *Rhinoceros antiquitatis*, the 'rhinoceros of antiquity.' The export ivory industry of Siberia, dating back to very ancient times, furnishes a very good idea of the immense number of mammoths that have been discovered by exploring parties in the frozen ground of Siberia, estimated by Middendorf (1885) at 20,000 during the past two centuries and by Nordenskiöld (1882) at a very much higher figure. The highest estimate is 46,750 for the last two and a half centuries, although one estimate even puts the number at 250 specimens annually, a total of 62,500 for the two hundred fifty years. The northern ivory trade to China is now traced back as far as 500 B.C. Doubtless the value of northern ivory rose as the Chinese gradually exterminated their own native or imported breeds of elephants from India.

[1] I. P. Tolmachoff: The Carcasses of the Mammoth and Rhinoceros Found in the Frozen Ground in Siberia. *Transactions of the American Philosophical Society*, N.S., Vol. XXIII, Pt. 1, 1929.

Herbert Lang notes[1] that Ides, the famous Dutch traveler and ambassador to China, seems to have been the earliest to gather first-hand information regarding the frozen Siberian mammoths. In traversing northern Siberia between the years 1692 and 1695, Ides learned that many of the Yakuts, Tunguses, and Ostyaks steadfastly believed that these huge monsters spent their lives deep underground, moving about easily in spacious tunnels even though the earth was thoroughly frozen. Should they become particularly active, the whole ground might rise above them, caving in later as they passed on; but should they come to the surface and breathe the warm air, they instantly died.

Like many other fossil mammals the mammoths appear to have become rather suddenly extinct after the climax of the Old Stone Age, namely, during the slow northward recession of the final great glaciers of Scandinavia and North America. The cause of their disappearance at the very moment when they reached the highest degree of specialization and perfection of their grinding teeth (Page 240) is a mystery; it is attributed by Tolmachoff to further specialization and by Howorth to the universal flooding which accompanied the sullen northward retreat of the great glaciers. A more likely explanation is that during this unfavorable period the herds may have become numerically reduced by underfeeding through lack of grassy food during the summer season. During these decades the underfed mothers were probably unable to protect their young from the attacks of wolves and other carnivorous mammals. Fortunately for us, during the height of their supremacy in western Europe they had been superbly drawn, modeled, and painted by the artists of the closing period of the Old Stone Age. In fact, it was not very long after the recognition of the woolly mammoth as a true fossil that man was also discovered in the fossil state.

It seems as if the very gradual recognition of the woolly mammoth as actually an extinct elephant extended well over a whole century; in 1696 the Russian explorer Ludloff described the mammoth of Siberia under the name *Mammontova Kost;* two years later the German scholar Tentzelius defended against all sceptics the discovery of a really fossil elephant at Burg-Tonna near Gotha, but this classic skeleton has recently proved to belong not to the mammoth family but to the

[1]Herbert Lang: Problems and Facts about Frozen Siberian Mammoths (*Elephas primigenius*) and Their Ivory. *Zoologica*, Vol. IV, No. 2, 1927.

SKULL AND TUSKS OF THE WOOLLY MAMMOTH

Skull and half-grown tusks of a middle-aged male specimen of *Mammonteus primigenius* found on the Yukon River, Alaska. With advancing age these tusks would curve inward and cross in the middle line

MAP OF THE DISCOVERY SITES OF FROZEN CARCASSES OF THE WOOLLY MAMMOTH AND RHINOCEROS

The discovery sites of the woolly mammoth are indicated by black dots (•) and those of the woolly rhinoceros by crosses (+). (After Tolmachoff, 1929)

straight-tusked elephant family known as the 'elephant of antiquity'; in 1728 Sir Hans Sloane confirmed the finding of Tentzelius by reference to the discovery; seven years later (1735) John Phil. Breyne wrote to the Royal Society as follows:

> . . . I was busied . . . to prove, that the extraordinary large Teeth and Bones found under Ground, and digged up in several Places of *Siberia*, by the name of *Mammoth's* or *Mammut's*, Teeth and Bones, were,
>
> I. True Bones and Teeth of some large Animals once living; and,
>
> II. That those Animals were *Elephants*, by the Analogy of the Teeth and Bones, with the known ones of *Elephants*.
>
> III. That they were brought and left there by the universal Deluge. I made likewise several useful Inferences about this matter.

The first finely etched figure of the cranium of the mammoth brought by Messerschmidt from Siberia was published by Doctor Breyne in 1737 [1741?]. Thus step by step the way was prepared for Blumenbach to name the animal in 1799 and for the great Cuvier to thoroughly describe it in a series of memoirs between 1796 and 1834. Since that time our knowledge has advanced by leaps and bounds. The first bones of the mastodon found on the banks of the Hudson River in 1705 and of the Ohio River in 1739 were naturally confused in Europe with those of the mammoth when Blumenbach first labeled them *Ohio incognitum* and then *Mammut*. A century later, in 1842, DeKay described his *Elephas americanus*, a fossil mammoth tooth found in Monroe County near Rochester, New York. Finally, in 1924, the present author described his *Mammonteus primigenius compressus*, the most highly specialized and perfected mammoth thus far found, as known both near Rochester, Indiana, and in Alaska (see page 240).

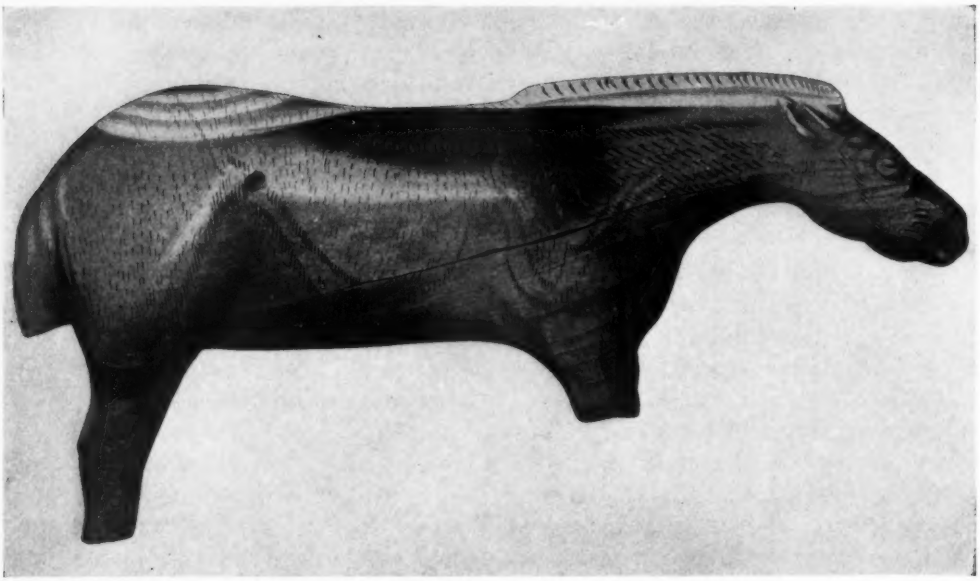
Beginning with the discovery of a complete frozen mammoth skeleton—known as the Adams' mammoth—near the mouth of the Lena River in 1799, other complete skeletons were unearthed and mounted in the museums of St. Petersburg, Leipsic, Stuttgart, and Brussels, all closely similar in size, in the wheel-like curvature of the

great tusks, in the extraordinary foreshortening of the skull (Page 240), in the rapid falling away or sloping of the hind quarters, in the shortness of the backbone and of the tail, in the reduction or complete loss of one of the digits of the hand—briefly, in the truly marvelous adaptation, in every part of the skeleton as well as in the teeth, to the very severe conditions of boreal life. In 1912 Felix described a mammoth found near Borna, whose death must have been so sudden that the animal did not have time to swallow a mouthful of food which lay in the form of a wad between the upper and lower teeth; in the stomach of this animal were about twenty-four pounds of undigested plant food, exceedingly interesting because it consisted of plants that are still native to the place (Berezovka River, northern Siberia), the tundra flora which the mammoths stored up during the short summer season for the long winter. These plants are *almost exclusively grasses* and form the characteristic meadow flora; the needles of conifers occur very rarely. From other discoveries we know that the mammoth fed during the winter on the arctic willow, *Salix polaris* of *Wahlenberg*, and on other northerly dwarf plants.

The description by Felix not only gives us complete knowledge of the skeleton of *Elephas primigenius* but shows conclusively the proper position of the tusk in the jaw and also its inclination. As to the animal's outward appearance, it involved a number of corrections in even the best reconstructions that had been made; the proportion of the length of skull and trunk in the mammoth is quite different from that of existing elephants: in the mammoth the skull is more than half the trunk length, in the elephant (*E. indicus*) it is always less than half. The

THE CHARGING MAMMOTH OF THE UPPER STONE AGE

This figure is engraved on the classic ivory tusk of La Madeleine, now in the Natural History Museum of Paris. As fully set forth in the text of the accompanying article, it represents the animal as he appeared in summer. (After E. Lartet.)



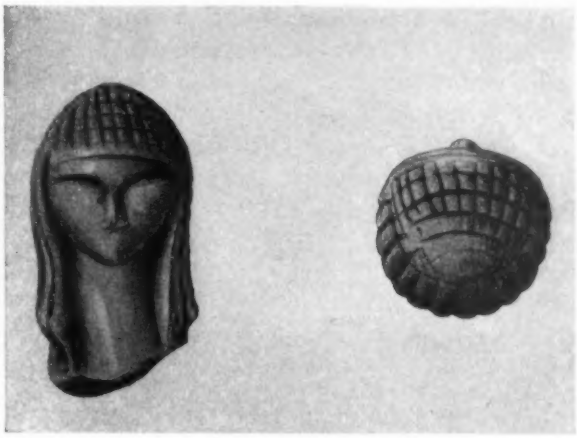
EQUINE IVORY STATUETTE FROM LOURDES
This statuette, found in the Grotte des Espélugues at Lourdes, is carved from mammoth ivory. Twice natural size. (After J. Pilloy in Edouard Piette's *L'Art pendant L'Age du Renne*, 1907.)

mammoth's head, therefore, was higher and larger in proportion to the body than that of recent elephants and in consequence the tusks could attain enormous proportions. The largest of the tusks in the Leningrad Museum measures no less than 13 ft. 8 in. and in the Franzens-Museum of Brünn there is a tusk that actually exceeds 16 ft. 5 in. in length, including the long basal portion of the tusk which was incased within the exceptionally long tube-like premaxillary bones shown in our figure (Page 240) of the female mammoth skull of Indiana, the type of Osborn's *M. primigenius compressus*.

The trunk of the mammoth was extremely well developed. The ear was somewhat smaller than that of the Indian elephant, being about 15 in. in length and 6.7 in. in breadth, and, like the rest of the body, was covered with a thick coat consisting of short wool and longer hair. The tail is conical in form, about 14 in. broad at the root, sharply pointed at the end where it terminates in a bunch of bristles. The skin was extraordinarily thick and underneath it was a layer of fat up to 3½ in. deep. The whole body was thickly covered with fine soft hair about an inch long, varying in color from faded blond to yellow brown; coarser and longer hair, sometimes 20 in. in length, of a dark, rust-colored brown, covered the entire neck and trunk, perhaps forming a fringe of hair still heavier and thicker from the cheeks along the shoulders and sides to the rump.

The above details regarding the external appearance of the mammoth are given very fully because they enhance the reputation of the Old Stone Age artists not only as close observers but as portrayers with marvelous fidelity of the external appearance of the woolly mammoth. Among the very numerous etchings, drawings, and paintings there is one which possesses high artistic merit as truthfully depicting the characteristics of the charging mammoth (Page 235). The majority of these

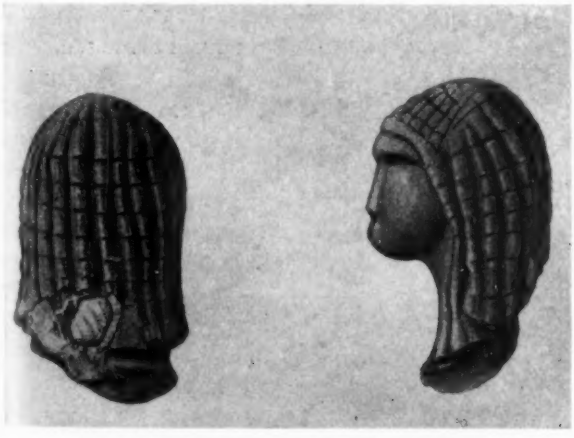
etchings and sculptures, as fully enumerated[1] in MacCurdy's encyclopedic volumes, are of the modern comic supplement order; they give the impression that our Stone Age ancestors were struck only with the humorous side of the mammoth as he appeared in the full panoply of his winter coat. But our increasing knowledge of these animals, derived from study of the frozen skeletons of Siberia and from the extremely close studies which Osborn is making in the preparation of his memoir, *The Evolution of the Proboscidea*, assures us that even the crude outlines on the walls of the cavern of Combarelles (Page 241) are not of the comic supplement order but are very truthful portrayals of the woolly mammoth as he actually appeared during the winter season, rounded out with his huge thickness of fat (three and a half inches in places) over the entire body and with a woolly covering extending down to his very hoofs and masking the muscular outlines of the limbs beneath. His extremely elevated head was followed by a deep nick or indenture of the neck, then by the rising hump of the back which sloped rapidly downward into the depressed region of the pelvis and terminated suddenly in a short, blunt tail.



IVORY FIGURINE FROM BRASSEMPOUY
Front and top views of a woman's head carved on ivory, found in a state of perfect preservation. (After J. Pilloy in Edouard Piette's *L'Art pendant L'Age du Renne*, 1907)

Thus the apparent caricatures of the Stone Age artists are realities; the mammoth in his winter pelage was even more disguised than the yak of Tibet. The sloping hind quarters served admirably as a watershed for the torrents of sleet and rain and the whirlwinds of snow that raged during the northern blizzards. Not only this, but the apparently weak and sloping hind quarters were all that the mammoth needed for the forward propulsion of his body, since, unlike all modern elephants, he never used his tusks for digging or uprooting purposes; consequently the hind limbs were not propellers of the body as they are in the African and Indian elephants of today. Another important feature is the bulbous or well-rounded

[1]George Grant MacCurdy: *Human Origins*. Vol. I, 1924, p. 265.



IVORY FIGURINE FROM BRASSEMPOUY
Back and profile views of the ivory carving shown above. (After J. Pilloy in Edouard Piette's *L'Art pendant L'Age du Renne*, 1907)

forehead, which rises like a sloping dome at the top of the otherwise pointed head; this swollen forehead, we are sure, was a food reservoir for the winter season which disappeared as winter advanced into spring, when the deep fatty covering all over the body was exhausted and the animal began to assume the normal outlines and proportions of other elephants.

This interpretation is to our mind absolutely demonstrated by the contrast between the comic outlines of the Combarelles mammoths of midwinter and the wonderfully spirited charging mammoth of midsummer engraved on a section of mammoth ivory tusk discovered beneath the Magdalenian shelter of La Madeleine along the Vézère River, reproduced with slight modifications on page 235. Here we see that the round fatty outlines of winter give place to those which conform very closely to the lean profile of the summer season; the high, peaked skull especially, with its characteristic concave forehead, affords us a view of the actual summer profile of the mammoth which corresponds with that of the Indiana mammoth shown on page 240. The classic Magdalenian engraving is one of the most realistic pieces of Palæolithic art that has ever been found; there are indications that the artist used the relatively small piece of ivory for the representation of three mammoths, for the tusks and trunks of two other elephants appear in the distance. Observe especially the outline of the ear, the elevation of the highly peaked, acrocephalic head, and the remarkably lifelike action of the limbs and body.

ARCHED TUSKS OF THE AFRICAN ELEPHANT
Giant arched tusks of the African elephant, 11 feet in length, presented, by Charles D. Barney to the Heads and Horns Collection of the New York Zoological Park

Toward the close of the Old Stone Age there began the wide-spread custom of the ceremonial burial of the dead to which we owe our really remarkable knowledge of the great hunting races that swarmed over central and western Europe during closing glacial time, succeeding the last of the Neanderthal race which seems to have had full possession of the river shores and caverns at the height of the fourth or last descent of the Scandinavian glaciers. Largely known by their flint implements found in the burials of hunters and warriors of Neanderthal time, we know little of their prowess; the Neanderthal flint implements are relatively small and clumsy and it would appear that the Neanderthal hunters were not equipped to pursue the large and formidable woolly mammoths of their time.

Succeeding the Neanderthals, however, was another race, probably from the Far East of central Asia, first found buried in the cavern of Aurignac and hence known as man of the Aurignacian stone culture. This race is known as the Brünn or Předmost; they are long-headed, with a narrow, short face and rather prominent brow ridges, and with brain development inferior to the broad-faced, artistic Cro-Magnons who drew and painted the mam-

moth. The Brünn people were apparently more interested in eating the mammoth than in depicting it, but they have left some sculptures in bone and ivory of both animal and human figures. This was one phase of the Brünn Aurignacian culture, but their culture is more largely known by their stone implements adapted to the making of clothing and to the killing of smaller kinds of animals—none of the Aurignacian implements so far found in western Europe was adapted to the chase of larger game. Evidence of the killing and consumption for food of a great number of the wild horses of the period has recently been found near Solutré in southern France, but, so far as I know, without the accompaniment of very large flint implements of the chase.

The discovery of giant killing flints by Dr. Carl Absolon of the University of Prague and the Museum of Brünn, one of the most distinguished archæologists of central Europe, is therefore a revelation not only of the pursuit of the woolly mammoth for purposes of food, but of the killing methods employed, whereby the animals were driven into great pits and then felled by giant stones let down by their captors. These stones appear like greatly magnified *coups de poings* of the long bygone Chellean and Acheulean age. The following passages may be cited from his recent description of his remarkable discoveries in the years 1924–1929 of mammoth-hunting stations of Moravia:[1]

Moravia was a kind of passage, by way of which the fossil mankind of the increasing Aurignacian tribe penetrated from Asia through Russia, to the West of Europe. . . . Of these [Lower Aurignacian] stations we now know about one hundred in Moravia, but only a small part of their area is explored as yet. . . . . They are: Věstonice, Předmostí, Petřkovice, Pekárna, and Ondratice. Pekárna is a cave; the rest of them are in loess on the slopes of hills. Pekárna is the most important, Věstonice the largest of them. . . . This was the first culture of the Old Aurignacian invasion of mammoth-hunters coming from Asia, the cradle of mankind.

. . . One thing is certain—namely, that the mammoth-hunters killed these huge pachyderms in hundreds, and that in diluvial Moravia a great tragedy, like the destruction of elephants in Africa, took place. . . . In the refuse-heap discovered in 1925, no tusks were found in the whole area of 45 square metres; but in that encountered in 1926, on the other hand, three heaps of tusks were piled one over another, between which was left a narrow path (page 232). In the same year an imposing sight opened before our astonished eyes, when we discovered a field of huge pelvic bones of adult mammoths. The skulls are usually broken to pieces, because mammoth-brain was appreciated by primitive hunters as a delicacy. Nevertheless, we found an intact skull of strikingly large proportions in 1928. Long bones (femurs, tibiæ) were found also in strange position forming a half-circle, so that their broken ends all pointed in one direction: evidently the fire was kept alight by the fat which flowed out of the ends of the burning bones into the flames.

CIRCULAR TUSKS OF THE WOOLLY MAMMOTH OF SIBERIA

Contrast these circle-shaped tusks, 8 feet in length, of the male woolly mammoth of Siberia with the arched tusks of the African elephant shown on page 238

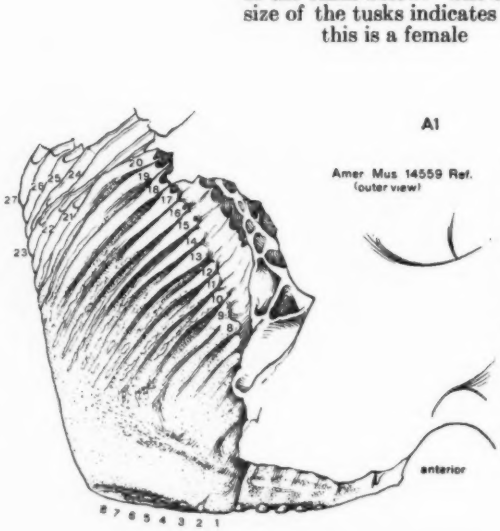
[1]Carl Absolon: An Amazing Palæolithic "Pompeii" in Moravia. *Illustrated London News*, November 23, 1929.

SKULL OF THE COMPRESSED MAMMOTH OF INDIANA

This remarkable specimen is matched only by a single find on Eschscholtz Bay, Alaska; it represents the extreme front to back compression, height, and depth attained in the cranium of the female woolly mammoth, named *Mammonteus primigenius compressus* from the extremely compressed and tall ridge plates of the grinding teeth, one of which is shown in detail below. Observe the great prominence of the eye sockets, narrowness of the brain case above, and the deep, narrow bony sockets of the tusks below. The small size of the tusks indicates that this is a female

GRINDING TOOTH OF *MAMMONTEUS PRIMIGENIUS COMPRESSUS*

Detailed aspect of the remarkable compressed superior grinding tooth of the right side of the compressed skull shown above. Here we observe no less



than 27 ridge plates, separately numbered in the drawing, whereas there were only 24 ridge plates in the typical *M. primigenius* of northern Europe, Alaska and the United States. This is the most elaborate dental mechanism ever found in any mammal

THE CLIMAX OF THE "COMPRESSED" MAMMOTH EVOLUTION IN AMERICA

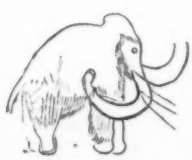
Lower jaw-bones lie generally apart, and the teeth have often been knocked out and piled up in heaps. In 1927 we found at Předmostí a jaw-bone within which was a red-painted stone club which might have been used for striking out the teeth from the jaw-bones—a unique discovery. From 1924 to 1929 we counted as many as sixty mammoths, all of them caught and killed by man, on the area of 1600 square metres.

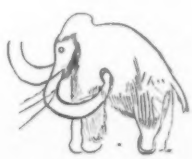
There cannot be the least doubt that the hunters did not attack these powerful animals face to face, but caught them by cunning, enticing or driving them into large pitfalls. . . . Mammoths trapped and caught were killed by large stones, trimmed to serve such a purpose. I have found one such stone, trimmed like a big pear, or bomb, 1 metre long, and weighing over 120 pounds (Page 232). These stones might have been suspended in strong leather straps and thus let down on the animals by the united efforts of several men, in the same way that navvies drive piles into river-beds by means of rams.

The woolly mammoth appears to have ranged almost exclusively north of the 40th parallel; it loved the borders of the retreating glaciers of the close of the Glacial Age both in Europe and North America. In Alaska it was extremely abundant and was occasionally found in frozen form along the ancient shores of Eschscholtz Bay. Alaska, broadly connected with the Asiatic mainland by a great isthmus bounded on the south by the present mountain peaks of the Aleutian Islands, yields abundant remains not only of the true woolly mammoth closely similar to the *E. primigenius* of Blumenbach, but also an extremely rare and highly specialized grinder (Page 240) to which the specific terminal *compressus* was recently applied by Osborn in descriptive relation to the exclusively compressed and fine-plated grinding teeth which attain the very high number of 27 compressed ridge plates above and below, in comparison with the 24 ridge plates above and below in *E. primigenius* of Siberia and western Europe. This proves that the marvelous adaptability of the mammoth did not cease when he entered the continent of America but reached even a higher point of specialization in his essential grinding tooth mechanism, just as we Americans pride ourselves today on our mechanical achievements.

This grinding tooth is a perfect marvel of adaptation and it is lodged below the very highly peaked cranium with a correspondingly deep depression and foreshortening of the jaw and approximation of the front and back planes of the skull which are so extreme as to appear almost artificial. It is this high, narrow, and deep skull to which the Greek adjectives hypsicephaly, acrocephaly and bathycephaly especially apply as absolutely unique in the animal kingdom; in adaptation to grassy diet it is the extreme antithesis to the long and relatively flat-headed cranium of the American mastodon which was the contemporaneous forest dweller of Alaska and as far south as Florida.

The woolly mammoth, however, like the polar bear, arctic fox, ptarmigan, and arctic reindeer, was at its best when in the severe climate of the far North, defying with its woolly covering the coldest arctic blasts. During the summer season it lost not a moment's time in laying in its grassy hoard for the coming winter, in comparison with its less hardy relative, the Jeffersonian mammoth of the mid-temperate region, and its subtropical and more remote relative, the imperial mammoth of the South Temperate zone.





THE NEW PLANET
A DRAMATIC DISCOVERY

A Brief History of the Planets Known to Science, and the Most Recent Triumph of Scientific Investigation

By CLYDE FISHER
Curator of Astronomy, American Museum

Then felt I like some watcher of the skies
When a new planet swims into his ken.
—JOHN KEATS

THE finding of a new major planet had occurred but twice since the dawn of history,—so one can understand the excitement occasioned during the early weeks of 1930 by the picking up of an ultra-Neptunian world. Predicted by the late Percival Lowell, and first "sighted" as a faint spot on a photographic plate, the discovery of the new planet was completely established by Director V. M. Slipher and the astronomers of his staff at the Lowell Observatory. A brief survey of the earth and neighboring worlds already known possibly will help us to appreciate this recent dramatic event, this triumph of scientific investigation.

To the ancients five planets were known, namely, Mercury, Venus, Mars, Jupiter, and Saturn. They, of course, did not know that the earth belonged to this group. In fact, for many centuries preceding the adoption of the Copernican theory of astronomy, it was thought that the earth was the center of the universe.

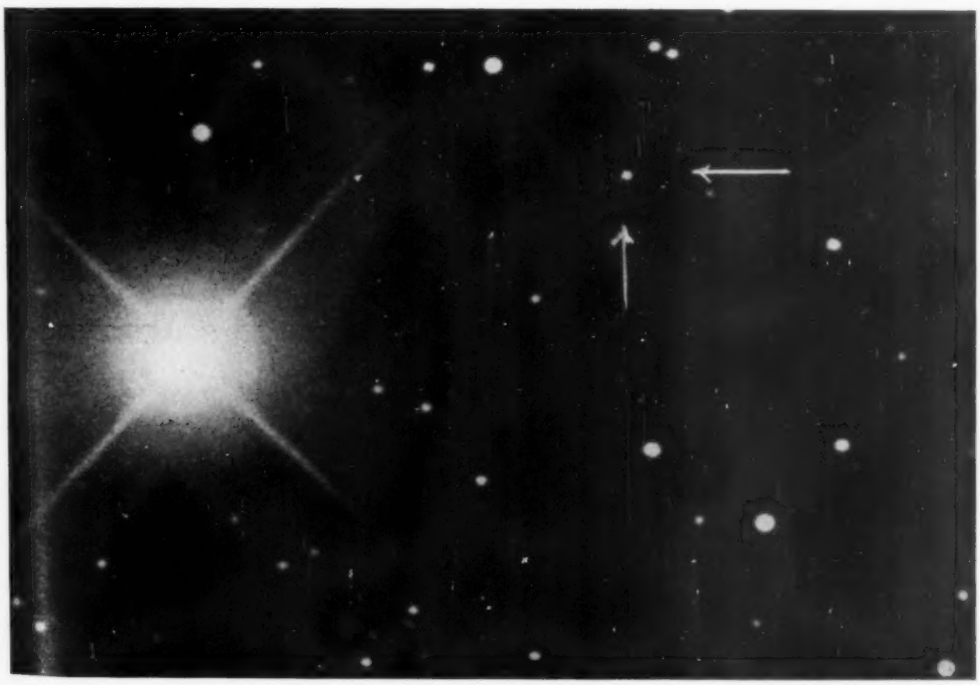
When we consider the matter, we realize that this geocentric notion was a natural conclusion to be drawn from observation. The sun was seen to rise in the east, to pass over the sky, and to set in the west, and the next morning it was again seen to rise in the east. It surely seemed that the sun went round the earth. The moon was seen to rise in the east, to pass over the sky and to set in the west, and the next day it was observed to rise again in the east. It also seemed that the moon went round the earth. (We now know the moon does go round the earth about once a month, but this motion does not account for its daily rising and setting.) The stars were also observed to rise in the east, to pass over the sky, and to set in the west, and the next evening the same ones were seen to rise in the east again. Thus it seemed that all the bodies in the sky revolved around the earth, and the earth seemed to be the center of the universe.

The great Ptolemy believed the earth to be the center of our family of planets, and his system was orthodox astronomy for fourteen hundred years. However, there came a time when this theory received a rude jolt. About the middle of the Sixteenth Century there was published a book by the great Polish astronomer, Copernicus, setting forth the theory that the sun is the center of our system of planets, and that the rising and setting of the various heavenly bodies is only an apparent motion due to the rotation of the earth on its axis.

Mercury is the innermost of the known planets, according to the Copernican system of astronomy. Although it is 36,000,000 miles from the sun, it is still so close to that huge incandescent body that it is generally overwhelmed by the light of the latter. It can be seen only

when at or near its greatest eastern or western elongation, that is, when it makes the greatest angle with the sun. It is so close to the sun that it goes round that body in eighty-eight of our days. We are not quite sure whether Mercury has an atmosphere, but very probably not. It is believed that it keeps the same side toward the sun all the time, and that the temperature of that side is high enough to melt lead. Mercury, like all the rest of the planets, shines only by reflected sunlight, and since its orbit is inside that of the earth it goes through phases as our moon does, and for the same reason. If Mercury had any satellites, it is believed they would have been discovered at one of the recent transits of the planet across the sun.

Venus is the second planet in order from the sun, and it makes the circuit around that central body in 225 of our days. Venus comes closer to the earth than any other of the major planets. It comes nearly ten millions of miles closer than Mars. When at or near its closest position to the earth, Venus is the brightest object in the sky except the sun and moon. There are only two known planets that can go through the crescent phase,—one is Mercury and the other is Venus. The first person to see Venus as a waxing and waning crescent was Galileo. If Venus had any satellites, it is believed they would have been discovered at the last transit of Venus across the sun. Only two planets can come between us and the sun, namely, Mercury and Venus. The last transit of Venus occurred in 1882, the next will be in the year 2,004. Very little is known about the surface of Venus because of the dense, opaque



Courtesy of the Associated Press

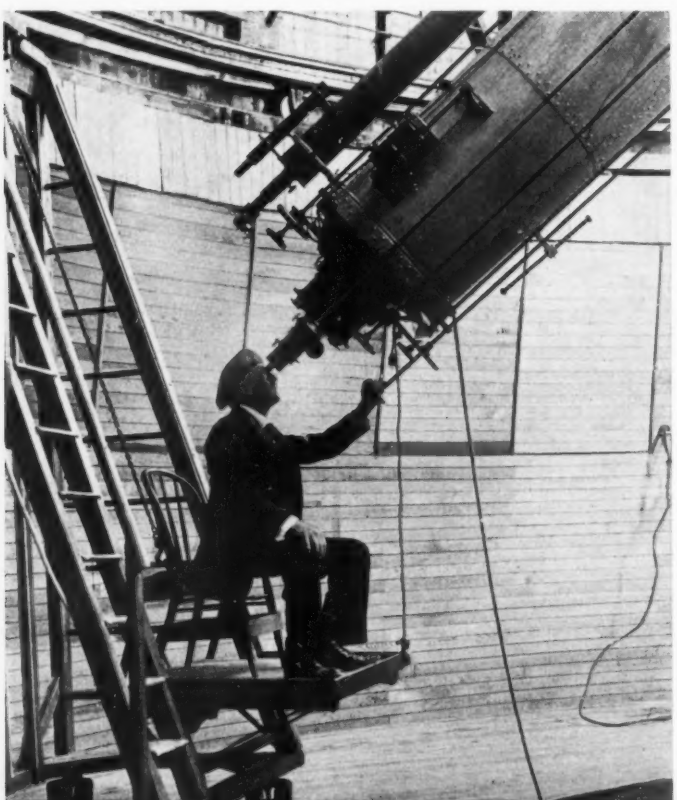
THE NEWLY DISCOVERED ULTRA-NEPTUNIAN PLANET

This photograph was made by Lampland at the Lowell Observatory. The position of the planet is indicated by arrows. The large, bright object at the left is the star Delta Geminorum, which is about 3½ magnitude. The cross-shaped marks on the image of this star are caused by the supports of the mirror of the reflecting telescope

atmosphere which surrounds the planet. This member of the solar system may have been given the feminine name because of its great beauty as a morning or evening star. When Venus is near the earth and the telescope reveals it as a thin crescent, resembling the new moon, the observer is no less charmed by the surprising beauty. Venus is now an evening star near Jupiter.

The earth is the third planet from the sun, although the ancients did not realize that it was one of the group of wanderers through the sky, five of which they knew besides. On our imaginary journey from the sun, the earth is the first planet that is known to have a satellite, and this satellite, which we call the moon, is the only body in the sky which goes round the earth. The moon completes this circuit in about four weeks, as can easily be observed. If one notices the moon on any particular night, he will notice on the next succeeding night at the same hour that it has moved eastward by about thirteen degrees, and this motion may be observed from night to night.

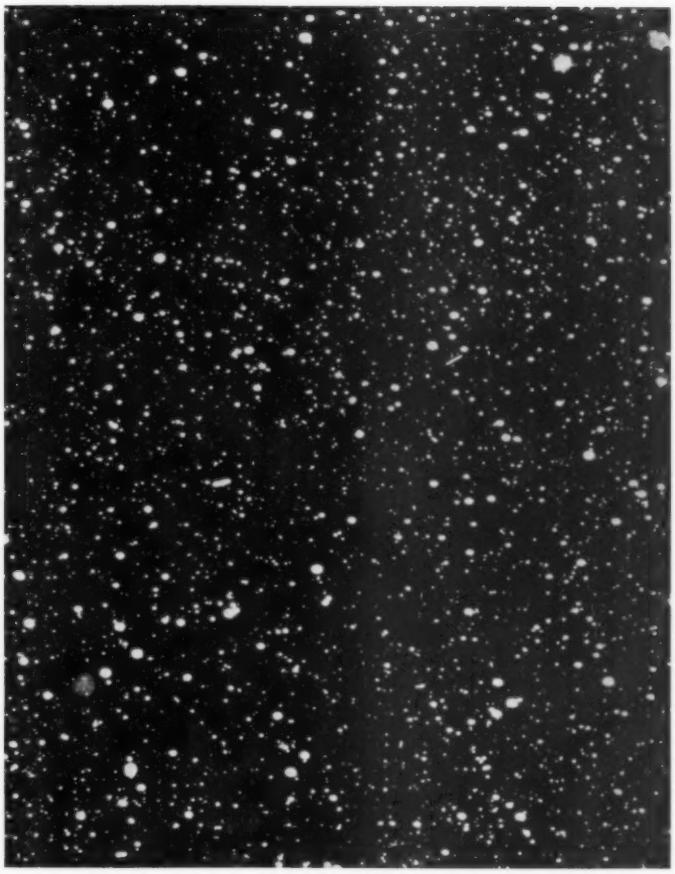
The mountains and craters on the moon were first seen by Galileo, through the first astronomical telescope ever made. These features of the moon's surface may be observed best at first quarter or on the two nights thereafter, or at the equivalent time about last quarter. At full moon there are no shadows to bring out the relief of the moon's surface. There are several ranges of mountains on the moon, the lunar Apennines being the most extensive. This is a slightly curved range four or five hundred miles long, and rivaling the Andes of South America in height.



THE FOUNDER OF THE LOWELL OBSERVATORY
Prof. Percival Lowell observing Venus in the daytime with the large refracting telescope of the Lowell Observatory. This photograph was taken about 1912

The so-called seas, so named by the ancients, are now known to be plains, for there is no water on the moon. A large part of the surface of the moon is abundantly covered by craters of all sizes up to one hundred miles in diameter, named for astronomers, philosophers, and others. The Crater Copernicus is fifty-six miles in diameter while the Crater Tycho has a diameter of eighty

miles. Two theories for the formation of these craters have been advanced, namely, the volcanic theory and the impact theory. According to the former they are thought to be due to volcanic action in a manner similar to the formation of volcanic craters on the earth. According to the latter they are supposed to have been caused by the falling of meteorites or planetesimals into the moon. There is one crater on the earth which seems to give weight to this theory, and that is, Meteor Crater in Arizona. Aeons ago there may have been many more on the earth, but if so, the agencies of erosion would probably have removed them. Since there is neither atmosphere nor water on the moon, these craters, regardless of their origin, have probably changed little or none. Their large size, whatever may have been their origin, is probably correlated with the lesser force of gravity on the moon than on the earth. A man weighing 150 pounds on the earth would weigh about twenty-five pounds on the moon. Therefore volcanic matter, or matter thrown by the impact of a body falling into the moon, would be thrown six times as far as on the earth. The moon with its "seas" and mountains and craters is a magnificent object through even a small telescope. One's first sight of the moon through the telescope can never be forgotten.

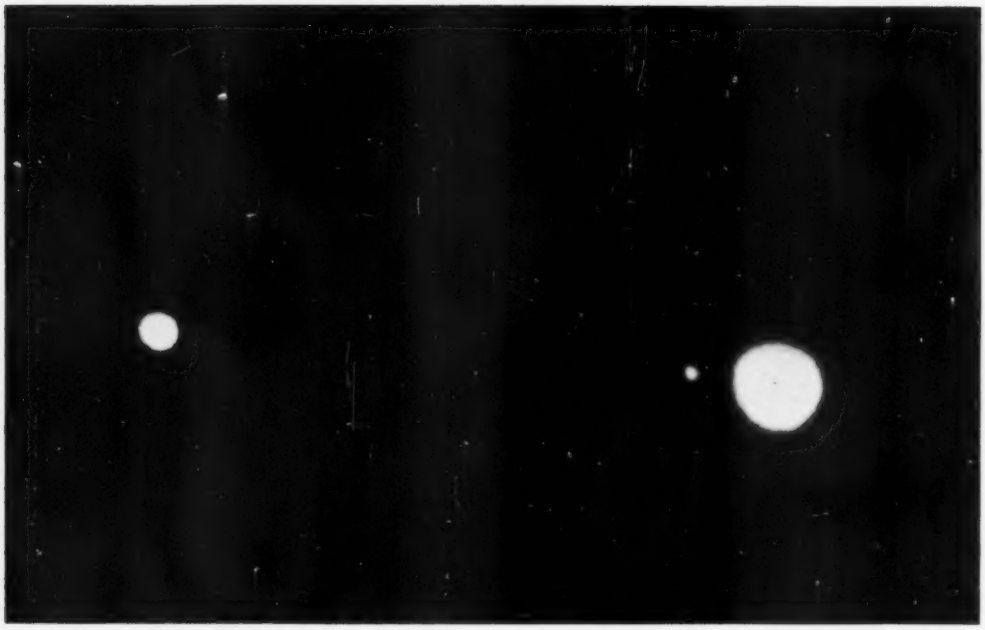


TWO ASTEROID TRAILS

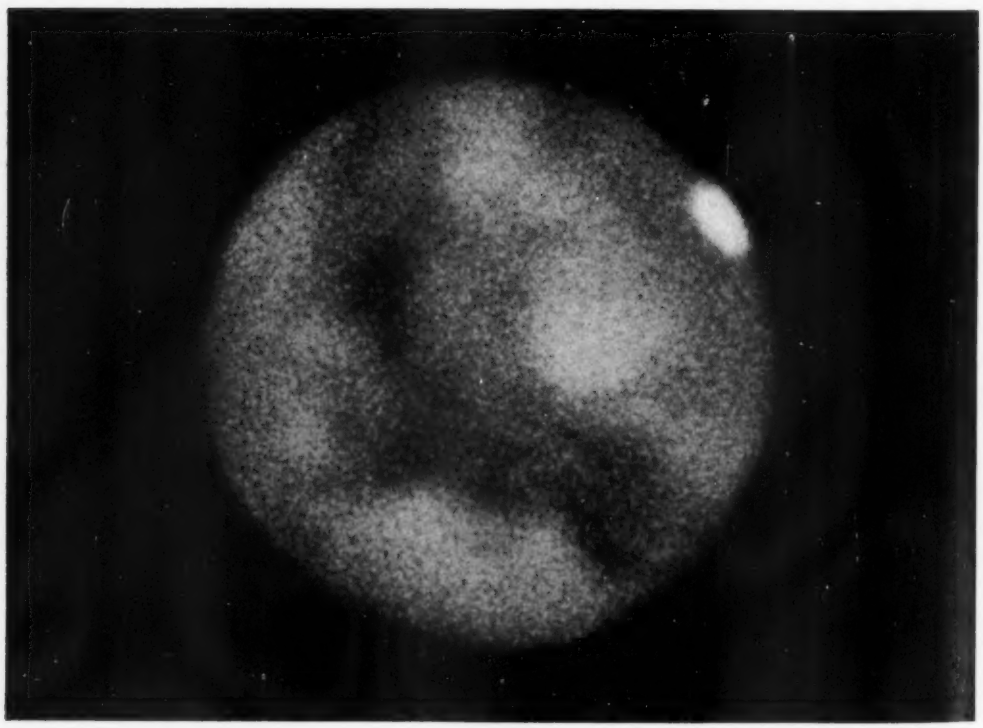
They are the long-shaped images among the round ones of the stars. The brighter trail is that of (28) *Bellona*. Photographed with the 10-inch Bruce lens at Yerkes Observatory. Exposure, one hour

Mars is the fourth planet from the sun, and next outside the earth. It is the one that appeals most to the popular fancy, on account of the perennial question of whether there is life on this neighboring world. Although Mars does not come as close to the earth as Venus, we are able by means of the telescope to make out much more about its surface, due partly to the greater transparency of the atmosphere of the former. Mars presents a ruddy surface relieved by darker areas, polar caps, and the much-discussed "canals."

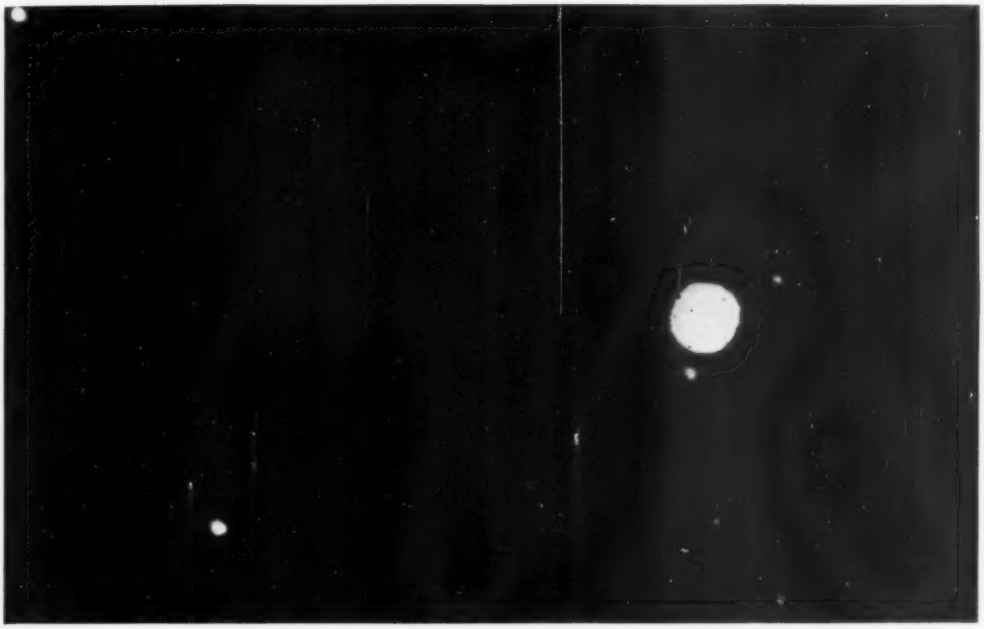
The polar caps can be seen with a small telescope, and they have been observed to change in size according to



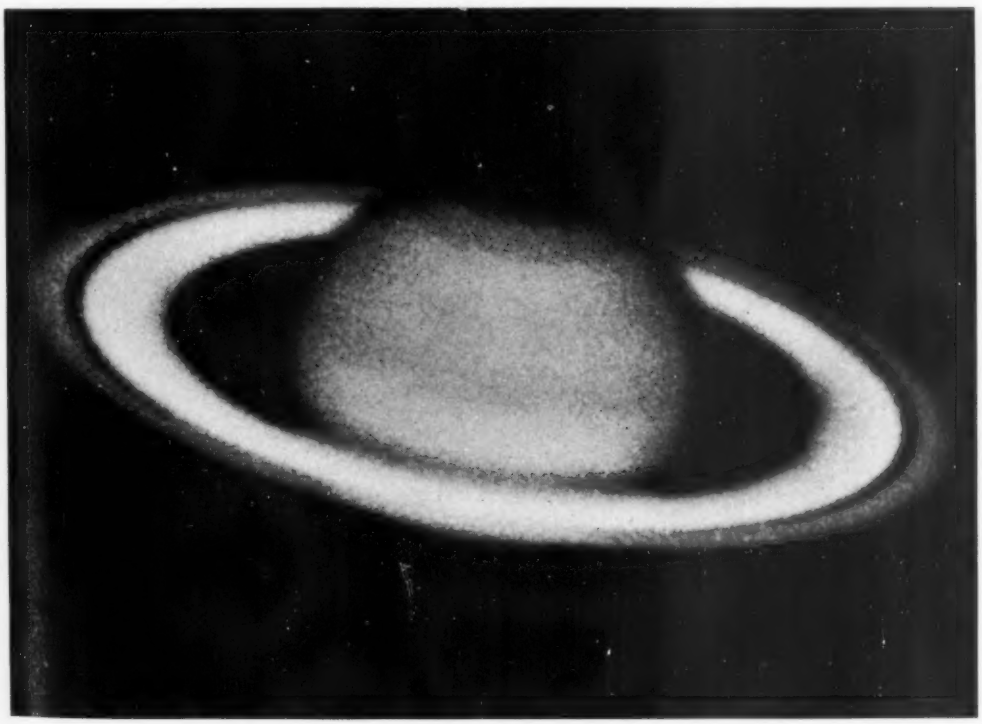
NEPTUNE AND ITS SATELLITE
The bright object to the left is a star. Photograph by Barnard with the 40-inch refractor at Yerkes Observatory



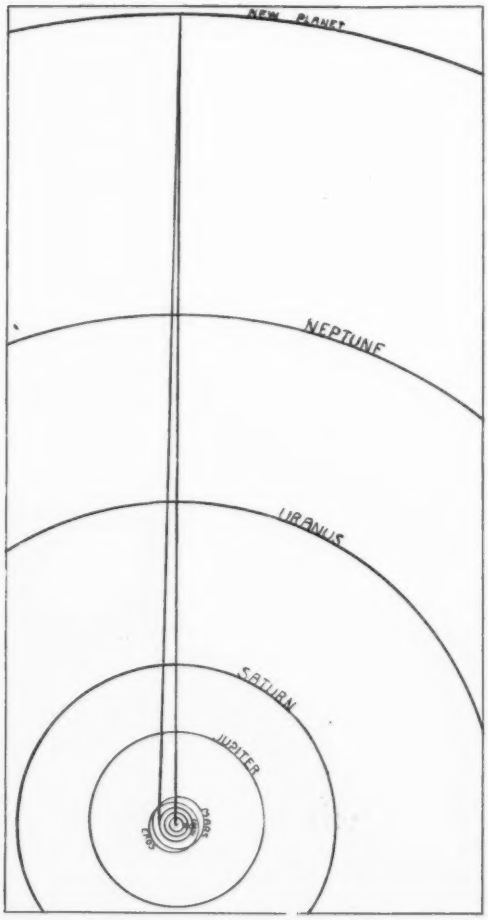
MARS
The south polar cap may be seen at the top; and Syrtis Major is visible as the dark wedge-shaped area pointing toward the north. Photographed by Barnard with the 40-inch refractor at Yerkes Observatory



URANUS AND TWO OF ITS SATELLITES
Uranus was discovered in 1781 by Sir William Herschel. Photographed by Hubble with the 24-inch reflector at Yerkes Observatory



SATURN
Some people consider this planet the most beautiful telescopic object in the sky. The rings here show Cassini's division. Photograph by Barnard with the 60-inch reflector at the Mt. Wilson Observatory



THE NEW PLANET IN RELATION TO THE SUN AND THE EARTH

To an observer on the new planet, the earth is so close to the sun that it cannot possibly be seen, except at a possible total eclipse of the sun by a satellite of the planet, if there be any. The narrow angle at the new planet gives the greatest angle subtended by the earth and the sun. Drawn by H. S. Rice

the season, just as the polar caps of the earth do, and it is believed for the same reasons.

The line-like markings on the surface of Mars, which were first designated "canals" by Schiaparelli, have occasioned much discussion. Whether they are waterways bordered by vegetation, thus making them wide enough to be seen through our larger telescopes, is still an unanswered question.

The axis of Mars is inclined almost the same as that of the earth; hence, the planet must have similar seasonal changes, since there is atmosphere and water on the planet, but on account of the longer time required for revolution around the sun (687 days), the seasons must be nearly twice as long as those on the earth. A Martian day is 24 hours and 37+ minutes in length.

Two satellites are known, having been discovered at a favorable opposition in 1877 through the large 26-inch telescope of the U. S. Naval Observatory by the elder Asaph Hall. When discovered, these satellites were the smallest bodies known in the sky. Now some asteroids are known which are estimated to be smaller. Phobos, the inner satellite, revolves about the planet in less than eight hours, that is, less than one third of a Martian day. Therefore, it must rise in the west and set in the east. Phobos is the only satellite known to revolve about its primary in less than the primary's period of rotation.

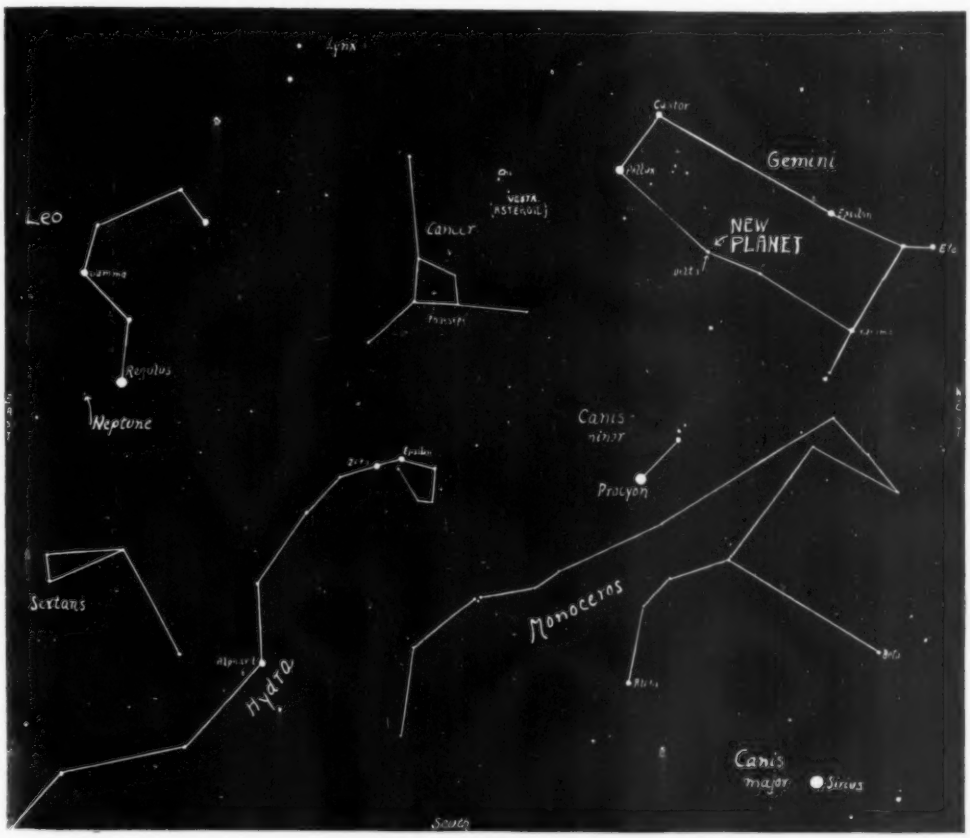
Since the temperature of the surface of Mars has been measured and found not too low to preclude the possibility of life, and since there is air with oxygen, and since there is water as vapor in the clouds, which however are rare, and solid in the polar caps, and probably liquid,—these conditions considered together with the motions of the planet—it seems to be the concensus of opinion among astronomers that there is life on Mars. This planet is too near the sun at present to be well seen.

The asteroids are to be found next outside the orbit of Mars. About 1500 have been discovered. One of them, Eros, due to its eccentric orbit, comes closer to the earth than either Mars or Venus. To the astronomer, Eros is an important body,—for one reason it affords the most accurate method of calculating the distance from the earth to the sun. Eros will make a very close approach to

the earth early next year, when it will be easily visible through a small telescope. Vesta, the brightest of these minor planets, is now in good position for observation with a small telescope. Last year an Austrian astronomer named a newly discovered asteroid *Hooveria* in recognition of Mr. Hoover's relief work in connection with the World War.

Jupiter is the next major planet outside of Mars, and it is also outside of the asteroids. It is the largest of the planets, and requires nearly twelve years to go round the sun. It rotates on its axis in a little less than ten hours. It has four large satellites and at least five small ones. The four large moons were discovered in 1610 by Galileo. The observed variations in the times of the eclipses of Io (one of the Galilean satellites) with the varying distance of the earth from Jupiter led Roemer in 1675 to make the first determination of the velocity of light. Jupiter presents only an outer surface of cloud, and definite bands in these surface clouds can be seen easily through a small telescope. The surface of Jupiter is cold, the thermocouple indicating approximately 100 degrees below zero Centigrade. Jupiter is now a conspicuous evening star not far from the Pleiades in the constellation Taurus.

Saturn, the sixth planet, is considered by some to be the most beautiful telescopic



A CHART OF A REGION OF THE SKY

Showing the position of the new planet on March 17, 1930. It will be noted that Neptune is near the first magnitude star, Regulus, in Leo; and that Vesta, the brightest of the asteroids, is near the beautiful star-cluster, Præsepe (the Bee-hive), in Cancer. Prepared by H. S. Rice

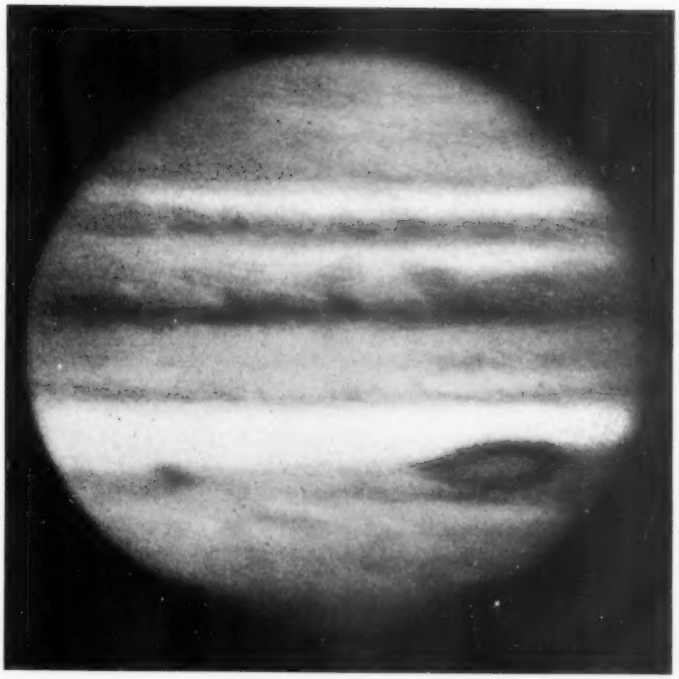
JUPITER

These three exposures on a small scale show changes in positions of the four Galilean satellites, due to their revolution around the planet. Photographed with the 10-inch Bruce Refractor at Yerkes Observatory

object in the sky, due to the rings, which were formerly referred to as "the fiery rings" of Saturn. Now it is known that these rings are composed of myriads of small solid bodies or moons, and that they are cold. Besides the rings, Saturn has eight relatively large satellites and one or two small ones. Saturn is so far from the sun that it takes nearly thirty years to go round the sun. Saturn is now a morning star in the constellation Sagittarius.

Uranus, the seventh planet from the sun, was discovered in 1781 by Sir William Herschel. He saw it as a hazy disc, slowly moving among the stars, and at first thought it to be a comet, and announced it as such to the Royal Society. Very soon, however, its planetary character was established, and Herschel named it Georgium Sidus in honor of the King of England. The name, "The Georgian," was used in the *Nautical Almanac* up to 1850, but it was disliked outside of England. Lalande proposed the name, "Herschel," which is found in some of the old books. Bode proposed the name Uranus. The planet has a revolution period of 84 years. Uranus has four satellites, the orbits of which are inclined to the plane of the planet's orbit and to the ecliptic more than 90 degrees, so that the motion of the satellites is really retrograde. Uranus is a telescopic object in the constellation Pisces.

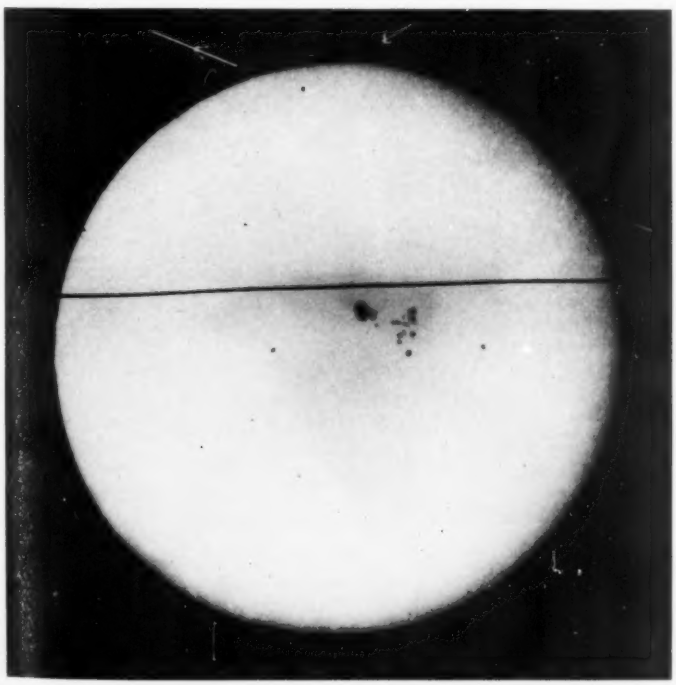
Neptune, the eighth major planet in order from the sun, was discovered in 1846, after its elements had been computed independently by Adams and Leverrier, the story of its discovery probably being the most dramatic event in the history of astronomy up to that time. The planet was found almost exactly where these two astronomers had calculated that it should be, from irregularities in the orbit of Uranus. Arago suggested that the planet be called Leverrier, and this name is found in some of the books published soon after its discovery, but the name was re-



JUPITER
Photographed by ultra-violet light, showing bands in the atmosphere. Courtesy of Yerkes Observatory

ceived with so little favor outside of France, that Arago withdrew it, proposing that of Neptune instead. Neptune requires nearly 165 years to complete one revolution around the sun. It has gone only about half way around the sun since its discovery. Neptune has one satellite, the orbit of which is inclined to the ecliptic 145°. Hence the revolution of this satellite is definitely retrograde. Neptune is a telescopic object near the first magnitude star, Regulus, in the constellation Leo.

On March 13, 1930, the scientific world and the general public were thrilled by the announcement of the discovery of a ninth major planet. On January 21st preceding, it had been "sighted" on a photographic plate as a faint spot, by Clyde Tombaugh, using a stereo-comparator. After this its motion was observed for more than seven weeks before public announcement was made of the discovery. Had it been a comet, it would have been observed to be moving rapidly toward or from the sun. The possibility of its being a comet was soon ruled out. By studying its motion, making allowance for the motion of



TRANSIT OF MERCURY, NOVEMBER 14, 1907
The planet is here shown near the top of the disc of the sun. Photograph by Fox with the 12-inch refractor at Yerkes Observatory

the earth in its orbit, the revolution period of the new planet was approximately determined. Then its distance from the sun could be calculated from its period. This distance considered with its magnitude made possible the calculation of its size.

The new planet was found in the constellation, the Heavenly Twins, near the third magnitude star, Delta Geminorum. At Lowell Observatory it was estimated to be 15th magnitude. Since that time at Harvard Observatory it has been estimated to be 16th magnitude. It is probably about the size of the earth, at any rate much smaller than Neptune. Its distance from the sun is approximately 4,000,000,000 miles. Its period of revolution around the sun is estimated to be between 300 and 500 years.

Light, which travels 186,000 miles a second, or 11,000,000 miles a minute, takes more than six hours to come from the new planet to us. The sun's disc, if viewed from the new planet, would be about as Jupiter is to us on the earth.

Using thirty and forty-five astronomical units, respectively, for the distances of Neptune and the new planet, Neptune receives 1/900 as much sunlight as the earth, and the new planet receives about 1/2000 as much as the earth, but full moonlight of the earth is about 1/500,000 of sunlight. Therefore the sunlight received by the new planet is about 250 times as much light as our full moon gives us.

Judging from the experience in the cases of Uranus and Neptune, it seems probable that it will be given some mythological name in keeping with the custom which is so far universal.

The discovery of this new trans-Neptunian planet was soon corroborated by Yerkes and by Harvard, and doubtless ere this time by many observatories. It was a great triumph for the scientific approach, the existence of such a body having been indicated by certain unexplained irregularities in the orbit of Uranus. Doctor Slipher and his associates deserve the highest praise for carrying to completion a dramatic project.

VENUS IN THE CRESCENT PHASE
Photograph by Barnard with 40-inch refractor at Yerkes Observatory

A symbolic dance of the Marquesans, representing conquerors and captives

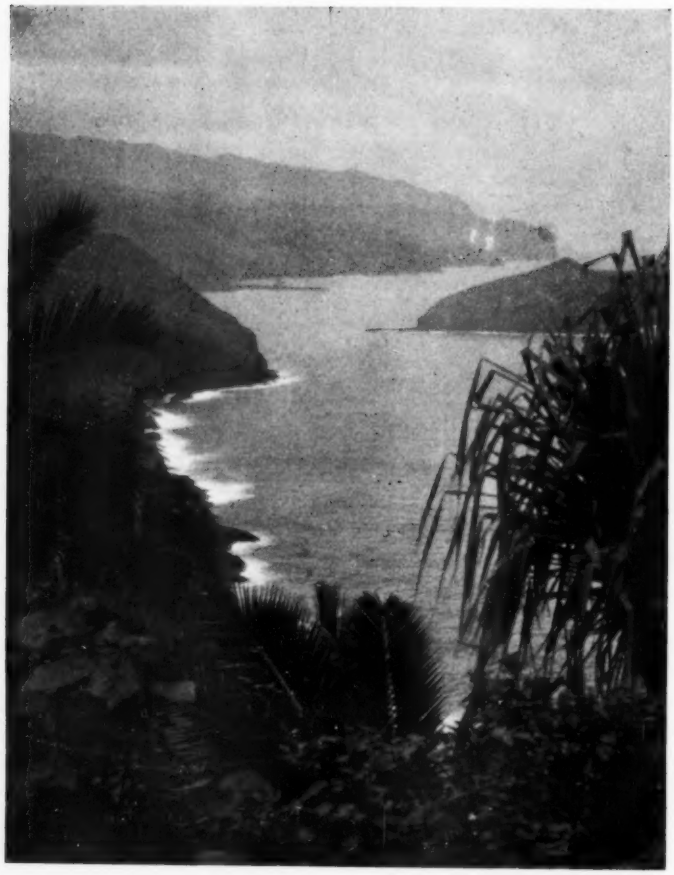
THE DISAPPEARING PEOPLES OF THE SOUTH SEAS

A Racial Survey of the Peoples of Polynesia by the Bishop Museum of Honolulu and the American Museum of Natural History—The Influence of Contact with Europeans on their Traits, Habits, and Social Organizations

By H. L. SHAPIRO
Assistant Curator of Physical Anthropology, American Museum

THE tradition of the romantic South Sea Islands was the inevitable result of the classic descriptions of Cook, Melville, and Stevenson. Any one who reads these protagonists of the Pacific scene absorbs forever something of the sunlight and color of those magic islands. And if the taste for such reading is once acquired, the modern writings of Calderon, Hall, Nordhoff, and Frisbie serve only to intensify the glamorous quality of the "fortunate islands." But the Tahiti of Cook and the Marquesas of Melville, except for their vitality in certain printed pages, are dead. Although it is depressing to see the disappearance of that heroic age, there are compensations in the charm of the reality. To appreciate that intangible characteristic one has only to see Tahiti defining itself in the dawn, Moorea wrapped in a blue moon, or the cliffs of the Marquesas rising in superb indifference to the foaming sea.

In such a setting one expects to find a consistent people. The first comers did,—Wallis in 1767, Bougainville in 1768, and Cook in 1769. The beauty of the Polynesian, his hospitality, and his natural physical and social grace created in the minds of the early navigators an impression of a race favored by the gods. To the subtlized sophistication and mannered artificiality of the Eighteenth Century, the natives of the South Seas were at the same time an anachronism and an ideal. Rousseau's "Natural Man" was



COAST LINE OF HIVA OA
The Marquesas are high volcanic islands with a precipitous shore. The sharp ridges which come down to the sea form deep bays which once sheltered weathered whalers

largely influenced by the accounts of the Tahitians brought back by his countryman, Bougainville, and by Cook. The interest in these people was so great that when Omai, a native of Tahiti, was brought back to England by Cook, he was lionized by London society eager to see a representative of those advertised people. Boswell gives, in the following passage, Johnson's impression of Omai.

Sir, he had passed his time, while in England, only in the best company; so that all that he had acquired of our manners was genteel. As a proof of this, Sir, Lord Mulgrave and he dined one day at Streatham. They sat with their backs to the light fronting us, so that I could not see distinctly; and there was so little of the savage in Omai, that I was afraid to speak to either, lest I should mistake one for the other.

Cook described the Polynesians of his day in glowing terms.

As to the people, they are of the largest size of Europeans. The men are tall, strong, well-limbed, and finely shaped. . . . The women of the superior rank are also in general above our middle stature, but those of the inferior class are rather below it, and some of them are very small. . . . Their natural complexion is that kind of clear olive, or brunette, which many people in Europe prefer to the finest white and red. In those that are exposed to the wind and sun, it is considerably deepened, but in others that live under shelter, especially the superior class of women, it continues its native hue, and the skin is most delicately smooth and soft; they have no tint in their cheeks which we distinguish by the name of color. The shape of the face is comely, the cheek-bones are not high, neither are the eyes hollow, nor the brow prominent; the only feature that does not correspond with our ideas of beauty is the nose, which, in general, is somewhat flat; their eyes, especially those of the women, are full of expression, sometimes sparkling with fire, and sometimes melting with softness; their teeth also are, almost without exception, most beautifully even and white, and their breath perfectly without taint.

Throughout this widely scattered area each group of islands seemed teeming with happy and vigorous people. And yet these discoverers would have been the last to conceive themselves as the bearers of destruction for the very people they praised so highly. Yet that was to be the result. During the period of discovery, contact with Europeans was of a slight nature, sufficient only to acquaint

the islanders with the reality of another world and arouse their imagination with the products of Europe. At the end of the Eighteenth Century the natives were essentially in the same condition in which they were found, except for the ravages of several European diseases which had been introduced. But in the next period —the period of missionary influence— which began about 1800, when the London Missionary Society sent out the "Duff" to Tahiti, native customs were broken down and irretrievably destroyed. As a result of the sincere activities of the missionaries, the natives lost their own mores but were not able or willing to adopt a complete new set. They were in a position to fall easy prey to the increasing influence of the whalers and traders. During the middle of the last century, great numbers of whaling expeditions called at the Society Islands and the Marquesas, and frequently spent a season in some sheltered valley. At Taiohae in Nukuhiva as many as a dozen whalers, anchored at one time, was not unusual. Considering the character of the whaling crews of that time and of the Polynesians themselves, it is doubtful whether the natives would have been able to resist the threat even if they were in their pristine condition. At any rate the inevitable consequence was the great increase of a half-caste population and the rapid decimation of the natives.

The question of depopulation in these islands is a difficult problem. The extent of this phenomenon is easily appreciated when one considers the changes which have ensued during the course of a little more than a century. Cook, who observed the preparation of a war party in 1774, writes of the population in Tahiti:

> We shall find by the estimate that the whole island can raise and equip 1,720 war canoes, and 68,000 able men, allowing forty men to each

MISSION BUILDINGS ON RAROIA

Catholic missionaries constructed these buildings about 1872. Previously the natives were pagan; they still are fundamentally. The French provincial touch is obvious in the architecture

THE VALLEY OF "TYPEE"

In this Marquesan Valley, Melville lived. Even now its fascination is still potent. One can easily reconstruct the gay river scenes and bands of maidens that Melville loved

VILLAGE STREET ON A CORAL ATOLL

The principal street in Takaroa, one of the Tuamotus. This island was once important in the pre-European history of the Tuamotu Islands. Now it basks in the sun

TAIPIVAI, MARQUESAS

Along these shores Melville was once pursued by Marquesan cannibals who were loath to part with his company. The peace of this almost land-locked bay is now never disturbed

TARO PIT AT KATIU

In the old days in the Tuamotus, pits were constructed for the cultivation of the moisture-loving taro, a tuberous vegetable. Now the pits are found abandoned on many of the coral islands

A TUAMOTUAN LAGOON

These bodies of water surrounded by a narrow circle of coral reef are extraordinarily beautiful. In the shallow water the coral floor is visible to the eye. The variegated tints of the water are due to these coral structures

canoe; and as these cannot amount to above one-third part of the number of both sexes, children included, the whole island cannot contain less than 204,000 inhabitants; a number which at first sight exceeded my belief. But when I came to reflect on the vast swarms which appeared whenever we came, I was convinced that this estimate was not much if at all too great.

Arii Taimai, the mother of the present Queen Marau of Tahiti, was able, from native sources, to say in her memoirs that this figure is not at all exaggerated as some writers have insisted. Contrast this figure, even if slightly overestimated, with the latest census return of 9,072 for Tahiti and Moorea, which is given by Roberts.

Even more striking are the figures for the Marquesas. In 1773 the population was figured as 100,000. This number has decreased steadily and rapidly to the latest estimate in 1920 of 1,800, given by Handy.

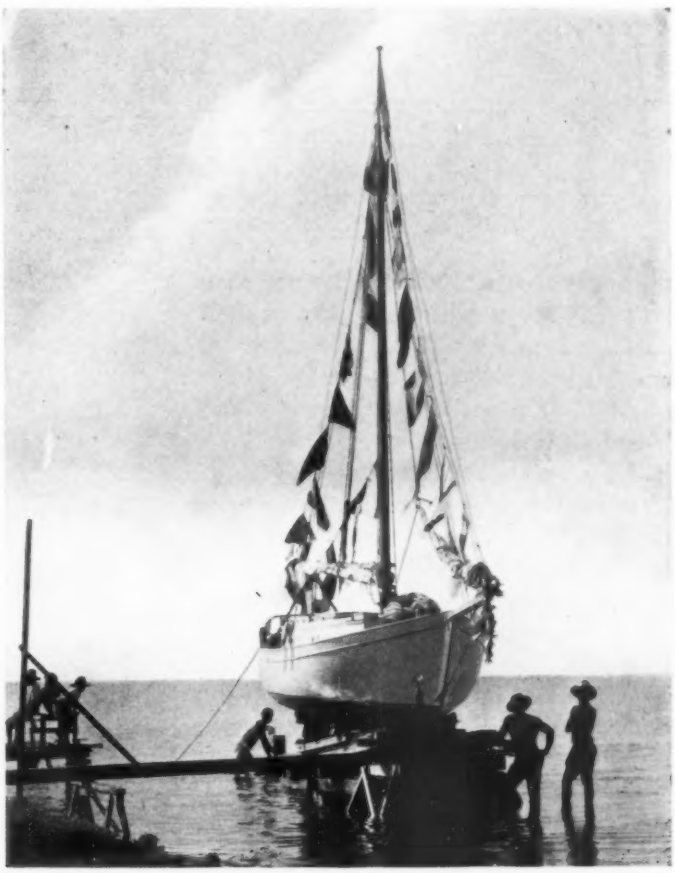
One could go on citing other examples of this phenomenon, but the actuality became poignantly real when in the summer of 1929 I cruised among the Marquesas in a trading schooner. There I saw fertile and verdant valleys emptied of all human occupants. Here and there in a few valleys were gathered a mere handful of survivors. The lovely valley of "Typee" where Melville lived amid a numerous brood of laughing youths is now the home of a few families, and so depleted is the population of the valley that it was with the greatest effort that we were able to gather a half dozen able-bodied men for measurements. In the Gambiers (Mangareva) the original native population is now practically extinct and is replaced by a half-caste population and immigrants from other islands.

Unfortunately for the elucidation of this perplexing problem, vital statistics for these islands are scanty and too generalized. Although the dramatic and sudden depletion which these islands have suffered is largely the result of introduced European diseases such as tuberculosis, syphilis, and measles, against which the Polynesians had no immunity, these epidemics do not tell the whole story.

In other parts of the world where new diseases have wiped out large proportions of the population, they have been able to recuperate the losses suffered. But in Polynesia, with a few exceptions there has been no recovery. We are also unable to determine for eastern Polynesia if the half-caste population is more robust and therefore increasing at the expense of the pure native strains, since there is no precise information of that variety. Furthermore, the half-caste population is constantly being increased by fresh admixtures, while the pure strains must necessarily depend on their own stock for addition to their numbers. Pitt-Rivers favors the belief that the excess of males in Polynesia is a large contributory factor to this persistent decline, but some evidence which I have gathered does not indicate a very marked differential birth rate between the sexes. It is true that families in Polynesia are small, but it is, however, dangerous to assume that this is the result of lessened fertility. Psychological causes which are sometimes adduced to explain this population decline do not seem to me to play a very important part in the problem. The natives whom I met in the Society Islands, the Marquesas and the Tuamotus do not appear to be laboring under any loss of interest in life on account of the decay of their cultural pattern.

It was this situation which led the Bishop Museum of Honolulu to initiate with the coöperation of the American Museum of Natural History a project to make a racial survey of Polynesia before the physical types were irretrievably lost through complete extinction or by race mixture. Although considerable data had been gathered since the initiation of this project, it was felt that additional material was necessary. Consequently I left America in March, 1929, to be gone a year visiting the islands of eastern Polynesia: the Society Islands, the Marquesas, and the Tuamotus.

If I had the space it would be amusing to list the various theories to account for



THE MAHINA-I-TE-PUA

For four months Doctor Shapiro cruised among the coral atolls of the Tuamotus in this cutter. The name translated means "Foam Flower"

THE CHIEF OF NAPUKA
The physical type shown above is found in Napuka and is very distinctive. Maono, the chief, is typical of his island

the origin of the Polynesian people which have had the uncritical support of various travelers and writers. We are all familiar with the traveler who can glibly account for most of the things he sees, where wiser men have labored in vain to find the solution. Unfortunately these hypotheses wander into print and become perpetuated in the bibliographies of each succeeding work.

The first voyagers to Polynseia reported that the Polynesian was one race from the Maori in New Zealand to the Hawaiian and from the Marquesan to the Samoan. To be sure, there was a certain similarity between all the Polynesians which characterized them as against the Melanesian, not only in physical type but in culture. But when more careful investigations were carried out, it became apparent that the Marquesan culture, for example, was not the same as Samoan, in spite of certain similarities due to common elements or to necessities of environment. The elaborate decorative art of the Marquesan also was seen to be distinct. Similarly, the Maori also has an individual art and social organization which have no exact counterpart anywhere else in Polynesia. Although this came to be recognized quite early in the anthropological studies of Polynesia, the physical type, partly because it had never been thoroughly studied, was considered to be homogeneous long after the culture was no longer regarded as a simple unit. Only very recently have physical anthropologists begun to recognize that the Polynesian is not a homogeneous subrace. Both Dixon and Sullivan have emphasized the heterogeneity of these people and have even attempted to isolate the elements which have contributed to the making of the Polynesian.

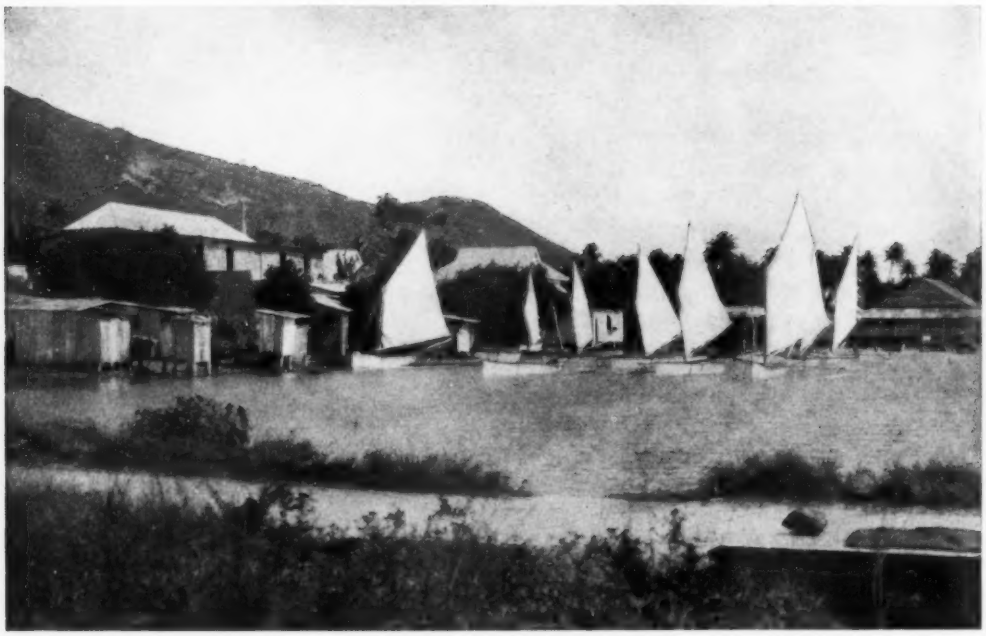
THE CHIEF OF HAO
Hao is one of the central Tuamotus. The chieftancy is elective, but the office is responsible to the French administrator of the Tuamotus

Part of the evidence for this belief in the heterogeneity of the Polynesian is the result of the series of studies for which the Bishop Museum and the American Museum of Natural History are responsible. It became evident that within each archipelago there were several types; that the distributions for various characters did not present a smooth curve, but that for many physical measurements there were peculiar groupings resulting in several peaks in each distribution curve. This is unlike the phenomenon which one finds in a homogeneous people where one type is the most frequent and the variations from that type are in decreasing frequency. Furthermore, when one group was compared with another, certain differences became apparent. For example, the Maori in New Zealand have a longer and much narrower head than the Society Islanders; they also have a shorter and narrower nose. On the other hand, the Samoans and Tongans show marked differences from the Society Islanders in their very long faces and in the proportions of the nose. In addition, there is evidence in Tahiti and Hawaii, to mention these groups only, of a distinctive type which preceded the present dominant one.

TUAMOTU GIRL
Polynesian-European hybrid backcrossed with Polynesian. This girl is one-eighth English. Her other ancestors were Tuamotuan

TAHITIAN YOUTH
This young man is a native of Tautira, the southernmost district of Tahiti. He is a typical representative of the Society Islanders

For that reason it is difficult to give a true composite picture of the Polynesian type. Nevertheless, there is a residuum of common traits which generally characterizes these people. They are among the tall people of the world. The average stature is about five feet seven or eight inches, frequently considerably higher than that. The hair is black, with decided reddish-brown lights in some individuals, and may be either straight, or as is often the case, wavy. Although frizzly hair is not common, it is occasionally found. In skin color the



YACHTING IN THE SOCIETY ISLANDS

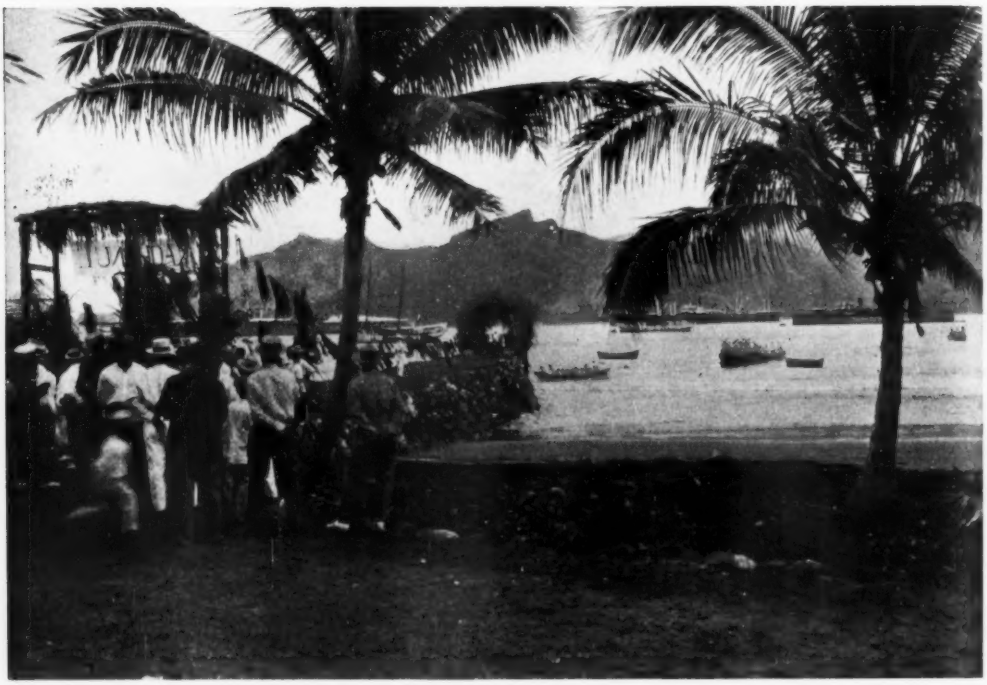
The small native outrigger canoes are very fast sailers. The village is called Uturoa, and is the principal one in Raiatea, formerly a famous religious center

HOUSING CONDITIONS IN NAPUKA

Houses of pandanus thatch are still used in this more isolated island. There are other types of thatched house—the niau—but no wooden houses here

EIANE, MARQUESAS
The cocoanut plantation shown in the foreground is the work of a Norwegian sailor who has settled in the Marquesas

CLOSE UP OF A NATIVE SAILING CANOE
The outrigger may be seen on the farther side of the canoe. It gives stability to the native canoes, which are extremely narrow



GREETING THE FRENCH

In 1929 the French cruiser "Tourville" visited Taiohae in the Marquesas. The natives, dressed in their best, are shown awaiting the landing of the ship's boats

Polynesian is light brown, often not much darker than a tanned European, although for the most part the men are more deeply pigmented by exposure to the sun. The eye is universally brown. The epicanthic or Mongoloid fold is found only occasionally, but it is not generally characteristic. The nose is medium in height but also wide. This character, together with the lips of medium thickness, gives to the Polynesian a slightly Negroid appearance, which, however, is not borne out by his other characteristics. The Polynesian also has a large, massive face, broad at the cheek bones, which is combined with a forehead narrow in width. The Polynesian generally lacks a heavy development of body hair, except on the legs; but moderate to heavy beards are not uncommon. The most recent views on the racial elements involved in the analysis of these people detect both Mongoloid and Caucasoid factors. Dixon believes that there are also Negrito and Australoid strains. Some students have tended to minimize the Caucasoid element, but in the light of material gathered during 1929 in the Tuamotus, we may have to assign a larger part to the Caucasoid element in the racial complex of some of the Polynesians.

So intimately associated are grass huts with the brown natives of the South Seas that it is a slight shock for the traveler to find Papeete, the commercial and governmental center for the French islands of eastern Polynesia, a town of wooden bungalows. The presence of these wooden houses may almost be taken as an index of the degree of contact with Europeans. On the more remote islands, native thatch huts are still to be found, but wherever traders frequent, the wooden house becomes a criterion of prosperity.

But despite such changes in his material environment the Polynesian has re-

mained essentially the same individual that he was a hundred years ago. He has, of course, given up tapa for Birmingham *pareus* and even for European dress. His diet has been supplemented by the introduction of flour, rice, tea, coffee, and other products unknown before the Eighteenth Century. And his tools are no longer of stone. But many of the specialized developments which fitted his environment perfectly have survived. The outrigger canoe still remains the ideal craft for the multiple uses to which it is put; basketry and matting retain their original function and are even adopted by European settlers.

Their methods of fishing, which were highly evolved before the arrival of the "popaa" or white man, are still practised. One of the most absorbing sports is spearing fish. I have often watched the natives, clad in red *pareus*, dive into the lagoons in the Tuamotus with spears in their hands, which they hurl at their prey. There is something exciting about man's invading a foreign element to match his skill against his quarry. The water is so clear that one can easily see the brown bodies of the natives, distorted by refraction, as they glide through the water. This form of aquatic skill is a part of every Polynesian's life. Frequently his life depends upon it.

In the Tuamotus the natives follow the pearl-diving circuit, proceeding to those islands opened for the diving. Often as many as five thousand natives will descend on an island where in off seasons only one hundred may live, and set up a bustling village with Chinese stores and a moving-picture house. As many as a thousand will be actively diving. Both men and women dive for the pearl shells from which the lucky ones obtain the coveted pearl. The best divers are able to descend 125 feet and stay under water for one minute. The exaggerated accounts of three minutes under water have never been authenticated. As a result of working under such high pressures, these divers often suffer from the "bends," which

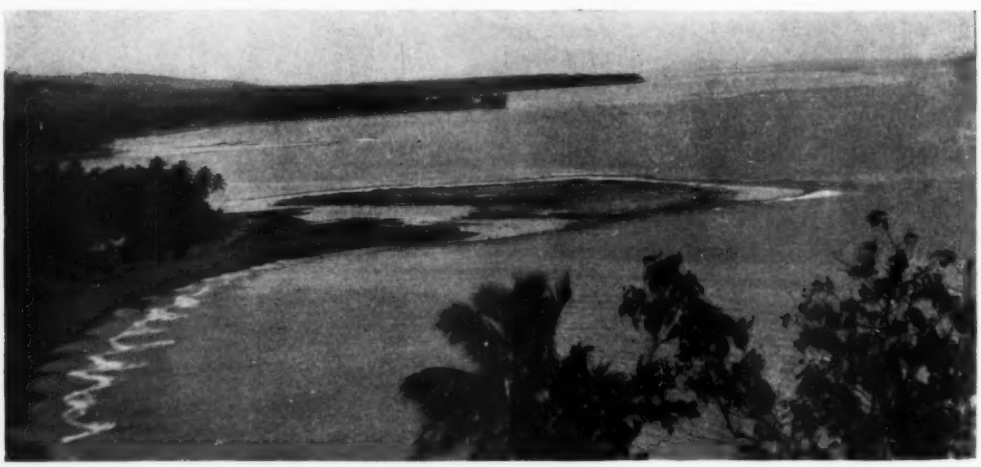
MARQUESAN YOUNGER GENERATION

Two outer rows of men and two inner rows of women make a typical formation for one of the Marquesan dances. The combination of European dress and grass skirt is amusing

incapacitates them for further diving.

Aside from pearling, which is mainly confined to the coral atolls that make up the Tuamotu archipelago, the principal industry of the natives of the South Seas is copra making. From the sale of copra they are able to buy the necessities of life and the luxuries of candy and a silk dress for the best girl. But food is never a great problem in the volcanic islands of the Society group and the Marquesas, for there the valleys are full of bananas, oranges, and other tropical food, and the surrounding sea is always full of fish. It is, however, in the Tuamotus that food becomes more of a problem. Here the only native products which can grow easily in the coral sand are cocoanuts and pandanus. Before the introduction of the cocoanut, natives of these islands lived on the pandanus nut and fish. But at the present time the cocoanut is a universal staple. Water in these low coral islands is collected in tanks after a rain storm, but drinking water is obtained from the young cocoanut, which fizzes like champagne when first opened.

One cannot leave these people, without a word about their singing and dancing. Song plays an important part in their lives, as it always has. The old chants are still preserved in the minds of the old people, and on occasions the elderly men and women would stay up all night until the crack of dawn singing for us these interminable chants in a monotonous rhythm, broken now and then by a falsetto. But the repertoire of the young consists mainly of hymns, sung with native words, often not consistent with our associations of the tune. Even American popular songs are spread with great rapidity until remote islands are invaded by these ubiquitous lyrics. These songs of the younger generation are sung to the accompaniment of a guitar which they play with great dexterity but without the steel that the Hawaiians have made famous. Dancing also is very important among the amusements of the young people, who are called "tarearea." This term embraces all the young folk who before marriage are allowed and even encouraged to be gay. It is their period of freedom during which they are allowed to choose their mates. For, after marriage such conduct becomes unseemly, even for the still spirited young married couples. Despite the apparent laxity in the habits of unattached young Polynesians, there is nevertheless a real feeling for the "convenances."



ARUE BEACH, TAHITI
This is in the neighborhood of Cook's landing place

A Mayan Home

"TOP OF THE WORLD" IN YUCATAN

Native Life on a Small Hacienda—Hunting for Fossil Mammals in the Land of the Mayas

By MARCELLE ROIGNEAU

Staff Assistant in Comparative and Human Anatomy, American Museum

Miss Roigneau, and her husband Robert T. Hatt, recently returned from a three-months' expedition for the American Museum to Yucatan, the site of America's highest primitive civilization. In the caves of a low range of mountains they searched for fossil animals that might throw some light on the obscure ancestry of the West Indian Fauna. Their headquarters was a plantation named Yokat a Mayan word said by the inhabitants to mean "top of the world."—THE EDITORS.

FULL of expectation we alighted from the train at the flag stop of Yokat, for here on the plantation we were to live the life of the Yucatan natives and share their food. In Merida, the capital, and in Chichen Itza, where we had spent three delightful weeks as guests of the Carnegie Institution, we had found English-speaking people; but here, in the Sierras, we would have to depend entirely on our not too extensive knowledge of Spanish and a few words of Maya.

We were met at the train by the intendant of the hacienda and a little tramvia drawn by a mule. We climbed in and in a few minutes were passing through a long alley bordered on each side by the huts of the Indian workers. Soon afterward we stopped in front of the *Casa principal*, which was to be our home until our work in the neighborhood caves was finished.

About Chichen Itza, in the beautiful forests of low trees and lianas, we had hunted and trapped living animals. In the Sierras we were to be fossil diggers and work by candle-light in dark abysses.

Señor Don Avelino Montes, the benevolent owner of many haciendas, had told us not to expect much comfort in Yokat, for he said the place was in a run-down condition. Our amazement was great, therefore, when we found that our house consisted of three large rooms—one

PLANTATION RAILWAYS

When we traveled to Ticul it was usually on these *plataformas* which an inspired mule pulled along at a rapid clip. Here, as usual, a crowd of curious children gathered around to watch the American señora who wore trousers

of them a bathroom with the luxury of a shower. Of course, when there was no wind to turn the windmill there was no water, and our shower was quite useless, but in any case we always enjoyed the sight of it. Our house also had a long, wide piazza just above the watering trough. At night toads would come to play near the water in the moonlight. If we ventured too near them, however, they would jump into the tank with a splash, only to reappear a moment later hopping on the stairs.

Our train had arrived in the late afternoon, but it took us only a few minutes to unpack our cots and then get ready for dinner. The intendant, Señor Espejo, took us to the house of his sister and her family, where he and many other Yucatecos working around the place seemed to take turns at the little table where meals were served.

Food is not plentiful in the interior of Yucatan, and our host was much relieved when we assured him that whatever was cooked for the others was good enough for us. Inadvertently I added that *frijoles* and *tortillas* sounded very good indeed! We found out afterward that *tortillas* were not very palatable, and that red beans, although always good, became rather monotonous when they appeared daily on the bill of fare. I must add, though, that, whenever possible, we were supplied with French bread (baked in banana leaves), and that most delicious *pan dulce* found all over Yucatan.

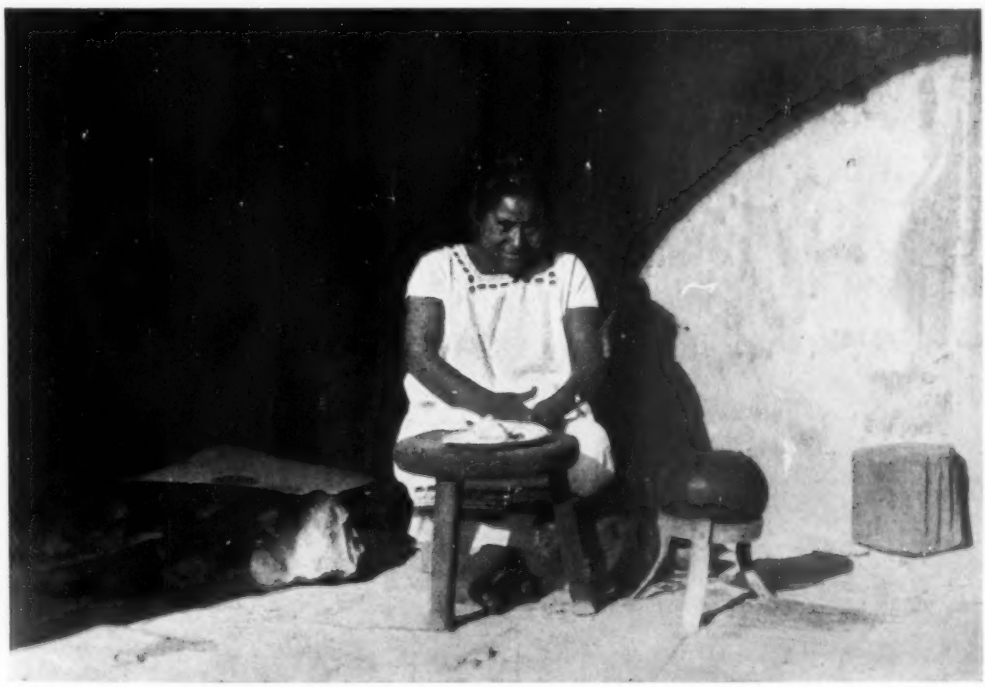
The next morning found old Barbaro, who was to be our guide, lying asleep on the steps of the piazza. He had been told to put himself at our disposal and was awaiting our pleasure. We tried to dismiss him until afternoon but in vain. There he stayed until after lunch, when, with him, and our guns ready for rabbits, we went walking through the extensive

henequen fields. From time to time Barbaro made a noise with his lips resembling the whining of baby rabbits, but that day none of those soft-furred rodents could be lured across our path.

Barbaro was an old Maya, slight of figure, but, like all of his race, full of endurance. He was intelligent and clever and nothing escaped his cunning eyes. His knowledge of the country and of the people was great, and his sense of humor always a source of enjoyment. As time went on we grew very fond of him and he always was our faithful follower. We particularly enjoyed going to Ticul with him, where, as soon as he entered the village, children would flock to him, calling him "Uncle," kissing him, and following him around. He had a great love for them and was always ready to do what they wanted.

Our second morning in Yokat found us up before the sun, and the fog lay thick over the Sierras. We hurried over to eat our breakfast before the flies should wake up. We had already learned their ways and had adapted ours to theirs. In the evening we would wait until dark for our dinner, when they would be asleep. The other pests of the dining room could not be evaded so easily, for it seemed to us that fat grunting pigs, thin hungry dogs, purring cats, and cackling chickens were by some magic forever awake, and nosing around the kitchen, or scratching their ticks close to us.

After breakfast that day, finding our horses saddled and Barbaro waiting for us, we started on a tour of the caves, in order to select the one which would afford the greatest opportunity for our work. We rode that day over the Sierras for seven hours, along uneven stony trails and through thorny bushes but we saw



OUR DAILY BREAD

As this Mayan woman patted out the corn meal mush of which the tortillas were made, she clicked and clucked away in her native tongue

MAYAN REBECCAS

The modern Mayan woman comes daily to the trough that is filled by American windmills, provided the wind blows. Her predecessor caught the drip water in the caves

only two caves, Actun Lara and Actun Jih.

Of the two caves, Actun Lara offered the best chance for digging, so early the next morning we were clambering down its entrance, loaded with picks, chisels, trowels, and candles.

As we entered, the swirling mass of swallows which were flying in fancy circles and chattering loudly soon disappeared, leaving us alone with the numerous fruit bats and swarms of excitable wasps. The place we had chosen for our work was a patch of red earth almost at the bottom of the cave, behind a big bowlder. We started digging, our minds busy with a host of questions. Would we find anything? If so, would it be worth while? Perhaps this was not the best place to dig? Yet it was the only patch of red earth! What would we find first? How deep would bedrock be?

Suddenly it seemed that someone was watching us; we could feel it. We looked up but there was no one at the entrance to the cave, yet that gaze was still upon us. Finally we discovered a small round skylight in the ceiling of the cave, at which two heads were clearly outlined against the bright sunlight.

We knew Barbaro was not one of them, for we had sent him to Ticul to buy lunch. Evidently news had traveled fast. Already people knew that we were digging in caves. We shouted a friendly *buenos dias* to our visitors. The answer came back, but the two Indian faces stayed at the opening a long time.

Some time after they had disappeared, we heard footsteps. Could it be Barbaro back so soon? No, the sound was that of feet clad in shoes and Barbaro wore silent sandals. Soon a tall, thin silhouette appeared at the entrance, followed by a smaller one. These interruptions were becoming annoying. Who could it be? Perhaps an official, for on the right hip

of one was the bulge of a revolver. The tall figure came down the steep incline toward us and soon we recognized the overseer of the hacienda, who had arrived the evening before and whom we had already met. So this was just a friendly visit and was a bit disappointing. The two Mayas of the skylight had stirred my imagination, and when the tall figure appeared, I was quite ready for something exciting. Our friend stayed but a few minutes and soon departed with his Indian boy. Before going, though, he asked us if we had found any gold in our diggings. Some Spanish gold, he said, had been buried in the caves, but as yet nobody had come upon it.

If our little trench did not hold any gold, it was, however, yielding specimens, and we worked steadily until Barbaro appeared with the lunch. We were hungry and wondered what he had bought. He had done quite well and we enjoyed a piece of bread and Edam cheese with some tiny French fried chicken entrails. We tried to induce Barbaro to eat with us, but it was evident that for some reason he did not want to sit down with us and share our lunch. He went out to look at the horses, and did not come back to eat until a long time after we had finished. Was the idea of caste so strong in him, that he was shocked at our invitation, or was it pride? It certainly was not servility, for Barbaro, like all the full-blooded Mayas, had dignity. Whatever his reason, it was deeply rooted, and, after another unsuccessful attempt the next day, we never asked him again.

Our small trench was becoming deeper and bones and teeth were piling up. Another pile I could not help making, although I knew that I would have to

TICUL BOULEVARD

The little thatched huts of the natives flank the streets. Behind them lie large yards where all their animals roam in muddy contentment. The tracks are not those of a street car, but a spur of a hacienda's field railways

leave it in the cave. Potsherds! We found many, some big and some small, some made of coarse clay, others of a finer kind. Some were blackened by long use on the fire; others, delicately painted, must have held only water. All were interesting for the stories they suggested of their ancient owners. Some day, perhaps, armed with a permit to collect archeological specimens, we can go back and find undisturbed those little piles of old pottery.

For several days we worked in Actun Lara, digging two trenches, the second one nearer the entrance and under a dent in a rock which an owl used as a dining perch for feasting on birds and bats, mouse opossums, shrews and mice.

Not only did we find old bones, but we also collected many bats. Usually, after lunch, we would spend a few minutes shooting bats hanging in holes too high for us to reach. Once, in a single hole of a low-ceilinged part of the cave, we caught twenty of a small carnivorous species, by applying a butterfly net at the entrance and then frightening these wonderful little mammals, which were caught in the net in their efforts to escape.

On one occasion we returned to Actun Jih, where, in a very small, low room at the end of a dark passage, one of us had seen a little red earth. One day of work was sufficient there, for the results were not very satisfying. Actun Jih was quite a distance from the hacienda and that evening as we were on our way back, we met a whole Indian family moving, each member carrying his load Maya fashion, that is on the back, with a strap across the forehead. The oldest man was in front, followed by the younger men, then the women, and finally the children, all in single file, although the road at that place was wide. The last of the long file was a tiny boy perhaps three or four years old

THE SUNKEN GARDEN

The roof fell, the sky flowed in and made a sunken garden of a dungeon; but bats and wasps, geckos and scorpions were the only creatures that lived near it

THE ENTRANCE TO MANHOLE CAVE
Big caves may have small mouths. This cave was probably the only thing in the jungle without a name, so the expedition called it "Manhole Cave"

who, like the rest, was bending under his load. Possibly they had walked all day under the hot sun, and had cut their way through thorny thickets, but they were Mayas, and the jungle was theirs.

Another day, on our way to visit a cave named Actun Has, we stopped in a clearing under which lay a cave for which the Mayas had no name. We had to enter it through a small round hole, less than a yard in diameter, by supporting the weight of the body with the hands flat on the rim, groping around with the feet to find the steep pile of rocks on which it was possible to sit down, and then jerkily slide to the bottom. It was a beautiful cave, with many chambers, but all unfit for excavation. We named it the Manhole Cave, and revisited it to get some bats.

Actun Has was really made up of two caves a distance from each other and communicating by a narrow passage not big enough for a man to go through. The first one was entered by way of a gentle slope covered with banana trees (*Has* in Maya), and was used extensively by hunters. The floor of fine sandy earth showed tracks of animals. To dig in this cave we would have had to look for its owner, and ask permission, but it did not seem worth while to lose the whole day trying to find the man, who might be anywhere in the jungle cutting wood. Furthermore, the appearance of the floor led us to believe that this cave would yield nothing of interest, so we decided to investigate the second part, and followed Barbaro along a narrow trail.

We stopped on the brink of a hole thirty feet in diameter. From the bottom of the cave rose many trees and we might not have seen the opening had not Barbaro stopped us. We went down with the aid of a rope, but afterward found that it was just as easy to go up and down by the lianas, thus freeing our-

CASA PRINCIPAL
In Spanish colonial days thousands of gateposts were built in Yucatan, no pair of which resembled any other

selves from the burden of the encumbering and heavy *riata*.

Upon entering the cave we found the complete skeleton of a horse. The poor animal had either fallen over the rim and had been held a prisoner until death, or had lain there wounded and helpless.

Having found a suitable place for a trench, we worked at it for several days, the noise of our picks accompanied by the loud chattering of brightly colored birds fluttering in the trees at the entrance. Unlike all the other caves we had visited around Yokat, this one contained no dripping water.

Our work here was drawing to a close and, although anxious to see new places, we felt that we had become a part of the life at Yokat. We had many friends there and, while not always able to take part in the conversation during the evening meal, we enjoyed hearing the old-timers speak of the Yucatan of many years ago. Often their stories started with "When Yucatan was covered with great big trees, and game plentiful. . . "

Though these people claimed to have seen such forests, it was hard for us to imagine them! Did they ever exist? Why is Yucatan now covered with low, impenetrable jungle? And how could the soil, rarely more than six inches thick, feed forests of such magnificent trees? But the story teller could not explain, he would only start his next anecdote with: "When I was only a boy, and Yucatan was covered with forests of great big trees. . . . "

By now, too, we had friends in almost all the little huts bordering the road along which we passed every day to go to the Sierras. Morning and night, when the innumerable dogs would announce the approach of our horses, the women would come out to greet us. The men, when home, would also join in with friendly words. In front of one hut I often stopped, for there was a family of beautiful little girls,—five or six sisters, with a laughing and friendly mother.

To us it was a revelation when we found out how many people and beasts could

live in a one-room house. It was with delight that we would watch the occupants come out of these modern Noah's arks. Father and mother with many children; several dogs and their respective families; turkeys and chickens followed by their broods; cats and kittens; pigs and piglets; and often, but not always, goats and kids. How they all lived in peace was a mystery to me!

My best Maya friend in Yokat was a woman employed by the sister of Señor Espejo. Every day she made the *tortillas*. Her skin was a beautiful warm bronze, and her eyes were full of laughter. Like all the others, she called me *niña*, but to greet me she would also put her two hands on my shoulders and laugh. She could neither speak nor understand a single word of Spanish, yet she was very talkative and always would tell me long stories in Maya. At first I thought she was trying to speak English, for a number of Mayan words sound almost like English words; finding out my mistake, I spoke to her in English, accompanying my words with many gestures.

Soon we were able to carry on a conversation, and the most amusing one to any onlooker must have been my description of a rabbit hunt at night. I am sure that she understood, because she was intelligent, and had asked me what we were doing the night before, carrying lights on our heads and guns in our hands.

At last the day came when our trunks had to be packed. For the last time we took a walk around the plantation, and in the afternoon left for Ticul, where we were to spend the night and the next day board a train which would take us farther along in the Sierras. There we would find the same people, the same pests, too, no doubt, and also that same atmosphere of tranquillity and indomitable independence which are the heritage of the Mayas.

ACTUN LARA

The toothed throat of the cave opened sharply downward, as if anxious to swallow any intruders and to add their bones to those already buried in its cavernous depths

CADDIS-FLY LARVÆ AS MASONS AND BUILDERS

Flexibility in the Case-making Behavior of Caddis-Fly Larvæ

By FRANK E. LUTZ

Curator, Department of Insect Life, American Museum

CADDIS flies, although classified as a distinct order, Trichoptera, seem to be very close relatives of primitive moths. Their larvæ are, for the most part, aquatic, and typically make cases within which they live. The simplest of these cases are merely thin silken envelopes in which silt or other foreign material may be enmeshed. However, perhaps the majority of species, certainly the majority of species whose life history has been recorded, build cases by cementing together bits of foreign material with silk.

"LOG-CABIN" TYPE OF CADDIS CASE
The fine white lines are strands of cotton which accidentally got on the case while in storage

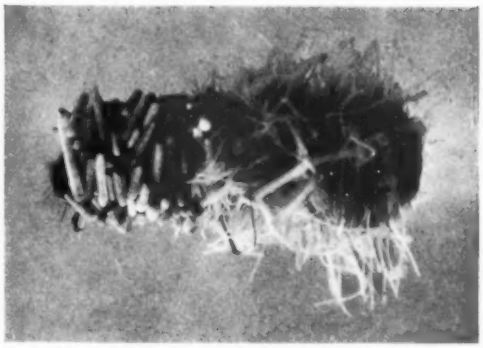
The interesting thing about these cases is that each species has a characteristic choice of material and a definite style of architecture. The choice of material is, naturally, limited to the things found in the particular aquatic environment which the species inhabits: vegetable matter, either living or dead, and harder, unchewable substances such as sand, small pebbles, and snail-shells. The architecture, taking the group as a whole, is most diverse, ranging from mere agglomerations of almost anything to a spiral case made of fine grains of sand so neatly and regularly fitted together that it was originally described as the shell of a snail new to science. But, whatever the style of architecture or the choice of material, it is usually characteristic of a given species, sometimes even of a genus or family.

There is a correlation between the kind of case which a species makes and the swiftness of the water in which it lives. Thus, the species which make a "log cabin" case of small sticks placed crosswise, as shown on this page, lives in relatively still water such as ponds, while one that fashions a "masonry mosaic" of pebbles (page 278) lives in streams. This is usually regarded as a wonderful adaptation of behavior *to* environment, but perhaps, since we do not know whether it was environment or behavior which changed, it would be better to say that it is an adaptation *between* behavior and environment. Certainly a larva that made a log-cabin case in a stream would soon be washed down to still water. It is not quite so clear why species that make masonry cases should not live in still water and, in fact, they sometimes do, but possibly one reason for their not being abundant in such places is that pebbles are not so apt to be available.

Since the caddis flies are a relatively

old group, being well represented at least as early as the Oligocene, and since certain types of cases are also characteristic of genera or even of families based entirely on anatomical characters of adult insects, it is quite probable that a species which builds a given kind of case now has built nothing but that kind of case for thousands or even millions of years. What would a caddis larva do if it could not get material like that to which it has been accustomed and, furthermore, could it live without a case as do other aquatic insect larvæ?

The answer to the first of these questions has been partly known for some time. Larvæ dispossessed of their cases have been given bits of mica from which to make new cases in order that students might be able to watch the actions of the larvæ within the cases. Ostwald, in particular, got larvæ to build with a great variety of unusual substances. In trying to find the answer to the second of the questions, I encountered a difficulty which had probably brought failure to others who said nothing about it, but I did find a few facts which seem to have an interesting bearing on the first question. These larvæ are vegetarians and, if given vegetable matter for food, nearly all, even the masons, not only could but did use it for making cases. Possibly by starving them sufficiently and then giving them only exceedingly small pieces of food at a time, one could force them to go without shelter rather than go hungry, or one could concentrate on the less adaptable; but, everything considered, the first question seemed to offer more interesting possibilities.

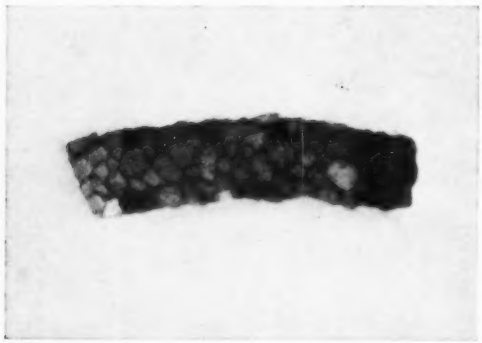


AN INSTANCE OF DELIBERATE CHOICE
A larva from a "log-cabin" case in one which it started by using pieces cut from *Utricularia* and finished, when it could get them, with sea-urchin spines

DOING WHAT IT CAN WITH WHAT IT HAS
A larva which normally makes a "log-cabin" case with sticks is here shown in a case which it made from broken shell and sea-urchin spines

For example, four log-cabin builders were dispossessed of their cases and put into an aquarium with nothing but water and sea-sand with a little alga for food. This experiment was being carried on at the Mount Desert Island Biological Laboratory and the available sea-sand was made up largely of fine pieces of broken shells. By the next day one larva had made a nice case of shells and sea-urchin spines; one used some of these, but mostly alga; and two were still naked. The following day three had shell and spine cases, the alga that one had used having apparently been worn or eaten off, and one still had no case, but there were two partly made and then abandoned cases in the aquarium.

The material normally used by the larvæ which build the log-cabin type of case consists of more or less cylindrical pieces of soft, partly decayed twigs or, in this Maine locality, of spruce needles



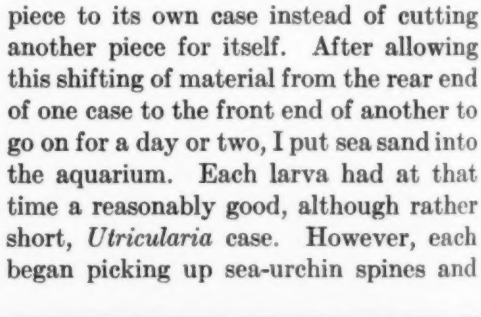
A "SAND-MOSAIC" CADDIS CASE
Normally, fine grains of sand are selected by this larva to build the case

which had fallen into the water. These are placed very definitely in a transverse position, with reference to the larva's body. When I put the sea-sand into the aquarium, I did not notice that it contained a small amount of sea-urchin spines. It was, therefore, a matter of considerable interest that the larvæ sorted over the sand and picked up here and there for use such a large proportion of the relatively rare objects which came nearest to being the shape of their normal material. That this was not because they could not use the flat pieces of broken shell is shown by the fact that they did use a few of such pieces and, in the case of one larva, it started with the exceedingly thin and flexible strands of alga, although it later changed to sea-urchin spines and some broken shell.

This seeming exercise of choice, a possible evidence of real mental preference, was further illustrated in another experiment in which dispossessed log-cabin builders were first put into an aquarium with nothing but water and *Utricularia*, a delicate plant bearing curious "bladders" or pockets which entrap microscopic organisms. Nearly all of the larvæ rather quickly made cases out of pieces of the plant which they bit off.

In order to understand more fully subsequent developments it should be remembered that such a larva constructs its case by making a narrow ring through which it puts its head and then it widens the ring by adding material to the front side until the ring has become a cylinder as long as, or longer than, the larva's body. New material may occasionally be added to the side of a case but, when the case is too short or for some other reason is not satisfactory, matters are usually adjusted by adding to the front end. Possibly the fact that the cases made by log-cabin builders, when they were forced to use shells and spines, were longer than normal was due to the insects' dissatisfaction with the new cases and their attempt to make them better by continued construction.

Be that as it may, the log-cabin builders in their *Utricularia* cases did not live peacefully together. One would come up behind another and steal a bit of plant from the case of the second in order either to eat it or to add that already-cut piece to its own case instead of cutting another piece for itself. After allowing this shifting of material from the rear end of one case to the front end of another to go on for a day or two, I put sea sand into the aquarium. Each larva had at that time a reasonably good, although rather short, *Utricularia* case. However, each began picking up sea-urchin spines and



LARGE BLOCKS SUCCESSFULLY HANDLED
A case built from broken shell by a larva from a sand-mosaic case

adding them to the front of its case, occasionally, as though by mistake, fastening one to the side. The figure at the top of page 275 shows such an instance. Eventually, because the *Utricularia* was either worn or eaten off, most larvæ had complete cases of sea-urchin spines.

Possibly the scarcity of broken shell in these cases, as contrasted with those made by naked larvæ which started with nothing but sea-sand and a little alga, is to be explained by the fact that these larvæ already had fairly satisfactory cases and, so, made a more leisurely and careful selection of material. I quite realize the danger of such a suggestion with its implication that larvæ of lowly creatures think. Possibly the preference shown for spines over broken shell may have a purely mechanical explanation in the shape of the tarsal claws with which the building material is handled, but I am at present unable to suggest a purely mechanical explanation for this preference being more completely manifested when the larvæ already had cases.

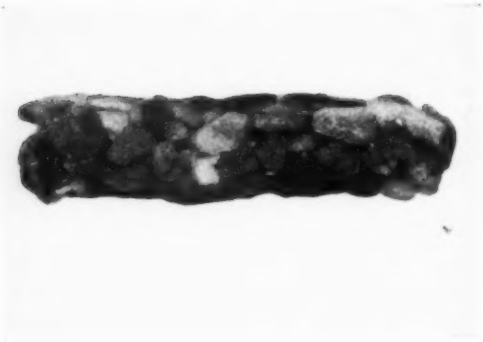
A SAND-BUILDER'S FIRST ATTEMPT WITH LEAVES AND STICKS

This case was made from "log-cabin" material by a larva which normally uses only sand

Larvæ that normally make a somewhat curved case of fine grains of sand (see figure top of page 276, in which a small bit is broken off from the hind end of the case) were dispossessed and given only the coarser bits of broken shell that had been sifted from sea-sand. In view of what has already been said, it is not surprising that they made cases of this new material. The experiment is mentioned here to show by the figure at the bottom of page 276 how well they handled the larger blocks, doing almost, if not quite, as well as a species which normally (page 278) uses relatively large pebbles, the sort of case that was referred to above as "masonry mosaic."

A more surprising result came when larvæ, dispossessed of their fine-sand cases, were given only spruce leaves and small sticks taken from log-cabin cases. Some with very little hesitation, others with more, made cases such as the one shown on this page. They did not arrange the material transversely, as do the log-cabin builders, but more or less longitudinally, as do many other species of caddis larvæ. There is no warrant for making much of the fact that this is a better arrangement of material for species which, like these sand-builders, live in relatively swift water, but we can say very definitely that what was probably the first attempt this species had ever made in constructing cases from such material resulted in a neat and apparently very satisfactory shelter of a type quite different from its previous experience but entirely normal for other species.

Masons such as the sand-builders just discussed or those that use small pebbles never cut material for their cases; they merely pick up pieces of suitable size. Therefore, the following experiment seems worth noting. On August 2, I dispossessed three sand-builders and gave them both living *Utricularia* and material taken from log-cabin cases. The next day one had made a case of spruce leaves, one used these and some fine débris, and one used spruce leaves but also pieces of *Utricularia* which it had cut off from the living plant. By August 6 this third larva had added sticks on the front of its case and



MASONIC CADDIS LARVÆ

These larvæ normally use pebbles for case-making. The head of the larva is seen at the doorway of its pebble case

Here a caddis larva is shown halfway out of a case which it made from pieces of decayed leaves cut by itself

had lost most of the *Utricularia* from the rear, probably by theft. Five days later, when all three had stick cases, I dispossessed two of them and put them in a new aquarium with only *Utricularia* in the water. In the same aquarium I put two fresh sand-builders: one which I had robbed of about half of its case, leaving it in the much-too-short other half, and one which I entirely dispossessed. I do not know how things fared by the next day, but on August 13 the three which were entirely dispossessed had good cases made of pieces of *Utricularia* which they had cut from the plant; the one with a too-short case had done nothing about it. Thus matters stood for several days, but later one larva disappeared—I am not sure which one or how. There was considerable fighting and stealing of material from each other's case until, when the experiment was stopped on August 26, one larva was naked (possibly the one which had had a piece of a sand case) and the cases of the other two consisted chiefly of the silken lining with small bits of *Utricularia* and débris still attached.

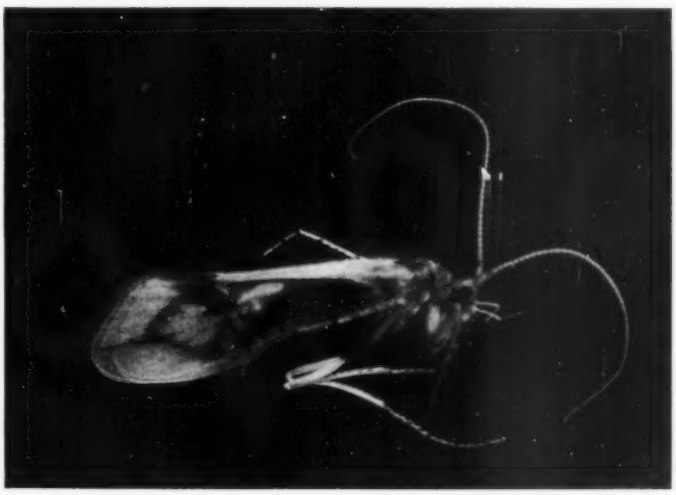
Apparently cases made of material which can be eaten—gingerbread houses, as it were—are not extremely satisfactory, except to the eater, but the experiment suggests the possibility that these larvæ, although not endowed by training and probably not by instinct with the notion of using vegetable material for their cases, can not only use such material but can do the, to them, unprecedented thing of cutting the case-building material into usable lengths. So far as this experiment goes the last statement is suggested as merely a possibility, there being the other possibility that they cut off pieces from the *Utricularia* for food and then, having the pieces, used them for making a case. However, the next and, so far as these notes are concerned, last experiment to be presented, seems to make the suggestion more probable.

Larvæ that make tile-like cases of relatively large pebbles, the "masonry mosaic" type shown on this page, were dispossessed and given the usual variety of unusual material. They managed them all so well that I finally gave some freshly dispossessed ones only large decayed leaves. Certainly these soft flat objects, too large to be fastened to a case without cutting, were very different from small, hard, round stones which are not to be cut. A creature whose ancestors to remote generations had never used anything but pebbles might not be expected to "think of" ("respond by" in more technical language) using decayed leaves or to be

able to use them whether it really thought about the matter or not. All that I can say is that it did cut pieces out of the leaves and from them made the case shown on page 278.

One thing that should be mentioned again has been touched upon from time to time in these notes. Not all of the individuals of any of the species which were given these tests solved the problems. Quite probably most of those in any given experiment were brothers and sisters, or at least closely related, as they were collected together, but some would be immediately successful with the new material, others were slower or less successful; some tried for hours and failed, leaving partly finished cases behind them, and some did not try. That the last fact was not due to lack of either silk or case-building urge was shown by their quickly making normal cases when given normal material. It almost looks like a variability of intelligence or ingenuity or something of the sort that many students suppose insects lack.

On the whole, without attempting to define either instinct or intelligence but selecting "behavior" as being the safer term, it seems clear that the case-building behavior of caddis-fly larvæ is at least a rather flexible affair. Other more debatable points will occur to those familiar with comparative psychology.



An adult caddis fly just emerged from the pupal skin

THE ART OF THE NORTHWEST COAST INDIANS

How Ancestral Records Were Preserved in Carvings and Paintings of Mythical or Fabulous Animal Figures

By LIEUT. G. T. EMMONS

THE "Northwest Coast" of America, known successively as the home of the sea otter, the land of the totem pole, and the salmon country, though never definitely defined as to limits, was accepted as the littoral between the Straits of Fuca and Bering Bay. Today the sea otter has vanished, the totem pole has been carried away or fallen, and the abundance of fish life is rapidly passing, but the thousands of miles of deep fiords and inland channels, shadowed by lofty snow-capped mountains, with broad glaciers reaching the water's edge, offer to future generations the scenic playground of the continent in compensation for what has been lost.

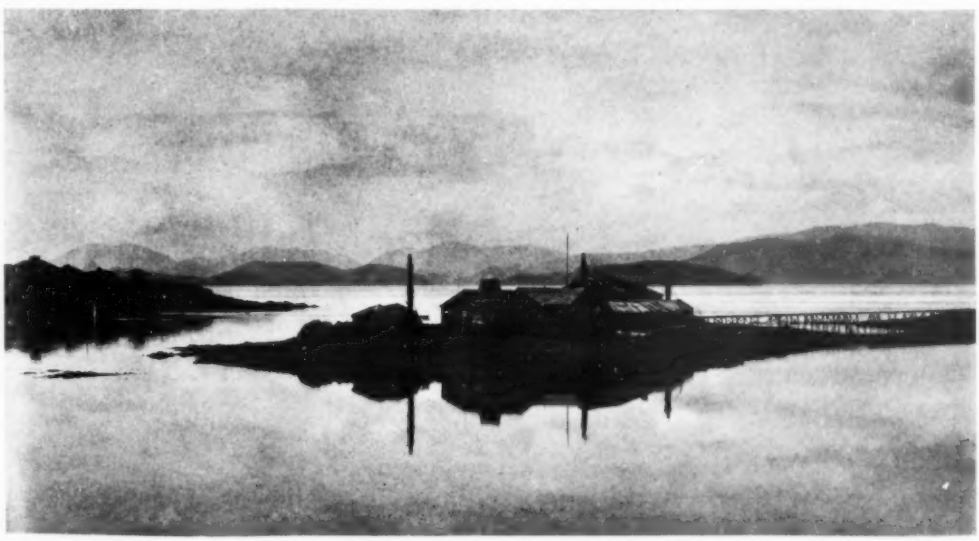
The distinctive features of the early life of this area was the artistic sense of the people as expressed in form and color, in the ornamentation of everything that they possessed, from the great communal house to the least important article of use. Their carvings, paintings, and woven fabrics, noticeably impressed the early explorers, who found it difficult to reconcile this excellence with their rude manner of life, and their primitive implements of shell and bone. Native copper they had in limited quantities, but without knowledge of its tempering it was useless for edged tools. Iron was not a product of the country and it was instantly demanded from the first traders above all else. By watching the ships' blacksmiths and armorers they became apt in manufacturing from it tools suited to their needs. With improved tools, their latent talent, which had been held in abeyance so long for a want of adequate means of expression, made rapid progress, reaching the acme of development during the first half of the Nineteenth Century, where its advance was suddenly checked by contact with our commercialized civilization, in the establishment of mining camps, salmon canneries, trading stores, and saloons, that attracted the younger generation, depopulating the native villages and destroying the old communal life. Fortunately, the art and culture of this Victorian Age have been preserved and can be enjoyed in the very complete collections in our principal museums.

HOUSE POST AT COMOX, VANCOUVER ISLAND

Of the five linguistic stocks inhabiting this coast, the northern tribes were matriarchal in descent and those of Vancouver Island patriarchal, which difference seemed to have influenced the character of their art. The primitive cultural center was about Dixon entrance. Here the Tlingit, Tsimshian, Kwakiutl, and Haida met, and through generations of migration, intermarriage, trade, war, and extravagant peace festivities, had formulated a code

of laws that was strictly observed. The unit of the social organization was the independent clan, represented by an animal totem around which their whole religious, political, and social life revolved. These clan totem animal figures were carved on the totem poles and house posts, painted on the house fronts and on interior screens, and shown on all household articles and ceremonial dress. I believe that the characteristic animal art of these people was born of this social system and was continually stimulated and developed through the intense clan jealously and rivalry of an extremely sensitive, vain, and proud people in their endeavor to outdo one another upon all ceremonial occasions, especially in the elaborate display of the crest or family totem. But this art served a useful purpose far beyond any sense of ornamentation. It was their figurative means of recording and transmitting their history, beliefs, myths, and traditions. It had come to them from a hazy past when, in the childhood of the world, human and animal life were on the same plane, and when some ancestor through sexual or beneficial relations had come in contact with the animal being which was later accepted as a guardian and honored accordingly, but this did not imply actual descent from or actual relationship with the later-day animal; it referred to something accepted but little questioned or understood.

Any notes on native art as contained in the narratives of the early explorers are naturally limited. They skirted the outer, uncharted coast, anchoring only when suitable water permitted, and met the people under the most unfavorable circumstances in their makeshift, temporary fishing camps. Even Vancouver's boat expeditions that traversed the principal inner channels saw few permanent winter villages, and those at a distance, owing to the suspicions and hostility of the inhabitants. His only mention of totem poles was at a small village in Fitzhue Sound, and of painted house fronts here and in Johnstone Straits, and while the natives claim that their villages had such ornamental features before the advent of the white man, yet they must have been of rare occurrence.



NANYAAYI VILLAGE, WRANGEL, ALASKA
A group of houses at Wrangel, southeastern Alaska. The Stikine Kwan 1888

IN CEREMONIAL DRESS

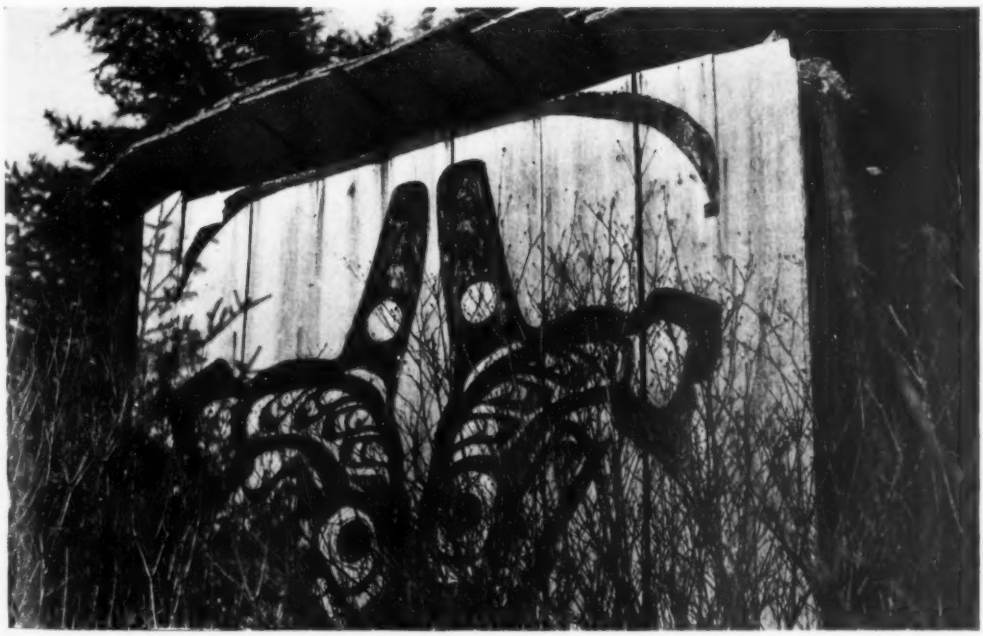
Members of the Nanyaayi family of the Stikine tribe of Tlingit at Wrangel, arrayed in ceremonial costumes decorated with clan totem animal figures

The acquisition of iron and the accumulation of wealth from the trade in furs changed all this, and photography, that came here in the Sixties, shows an abundance of both decorative poles and house fronts. Carving was largely dependent upon painting for its best effects. While the older totem poles, house, and grave posts may show the natural wood surface, yet practically all show evidence of color even in their decay. It is a question whether painting did not antedate carving as so much simpler in labor and material. The painting of the house front of the northern people was always in the animal crest, and might present a realistically natural or highly conventional form. In either case the figure was outlined in black, while red and blue-green were introduced in decorative faces, eyes, and even foreign figures, to represent the bone structure or to fill up vacant spaces. Interior paintings were much the same, although in some cases they elaborated detail to tell some incident in the family history.

The Nootka occupied the west coast of Vancouver Island south of Quatsina Sound, and a limited area about Cape Flattery across the straits. Although they were the first of the natives of this northern seaboard to come into more personal relations with Europeans, they have ever remained the least receptive and advanced of any of the native peoples. Their country, with its ragged, rocky, storm-swept shore, was redeemed by the many deep fiords and spacious bays, that served as spawning beds for countless schools of salmon, halibut, herring, and smelt, which were closely followed inshore by whale, porpoise, and seal; and about the outer rocks and kelp fields, the sea otter congregated. This abundant food supply supported a considerable population, and the trade in furs early gave them a prominence and wealth beyond other tribes. The Spaniards, who claimed the exclusive right to navigate the North Pacific, discovered Nootka in 1774, established a post in Friendly Cove in 1789, and maintained trade for a brief

period, after which these people were left to their own resources until 1860, when Sproat founded a colony at the head of Alberni Canal. From his writings we have the most authoritative story of the life of the Nootka. They were primarily sea hunters and the pursuit of the finback whale was their greatest industry. They were the only natives from the Straits of Fuca to the Aleutian Islands that hunted the whale. They were patriarchal in descent and lived in tribal communities of families holding the land in common. Marriage was restricted only in case of close relationship, and while the families possessed crests, they had little meaning and were used more as ornaments upon festival occasions. They had no totem poles originally, and the interior house carvings, figured by Cook and mentioned by all others, were rude, grotesque, and with little or no meaning. They used paintings on boards as screens upon ceremonial occasions and as decorative features against the interior back or side wall of the house over the chief's space or apartment. On these were represented mythical or fabulous monsters in animal form, and, for the prestige or gratification of the chief, around them some far-fetched story was woven. The figures principally shown were the Thunder Bird, the Lightning Snake, and the Whale, together with the Wolf.

The myth of the Thunder Bird, continent wide, while accepted by the northern tribes, plays little part in their art or ceremonies, but it is a dominant feature in the life of the southern tribes, and among the Nootkan it is associated with the Lightning Snake, "Hai-et-lik," a slave or weapon, worn around the body as a sash, that is cast down as a streak of lightning, killing the whale. The Thunder Bird is represented in the form of an eagle with possibly a slightly more

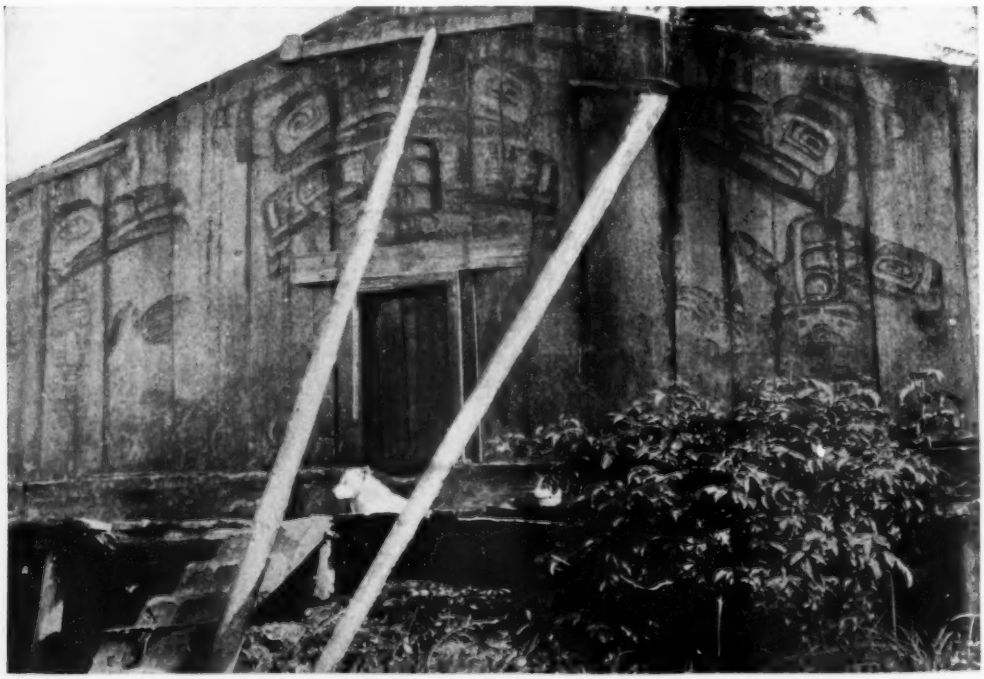


KILLER WHALE PAINTING ON A GRAVE HOUSE

This shaman's grave house bears on its front a painting representing two killer whales breaching. The killer whale was the crest of the deceased. The grave dated back to the early seventies, but the photograph was taken in 1889

INDIAN CHIEF'S HOUSE AT TUXICAN

The painting on this house at Tuxican, west coast of the Prince of Wales Island, southeastern Alaska, represents a whale. A raven's head forms the dorsal fin. 1888



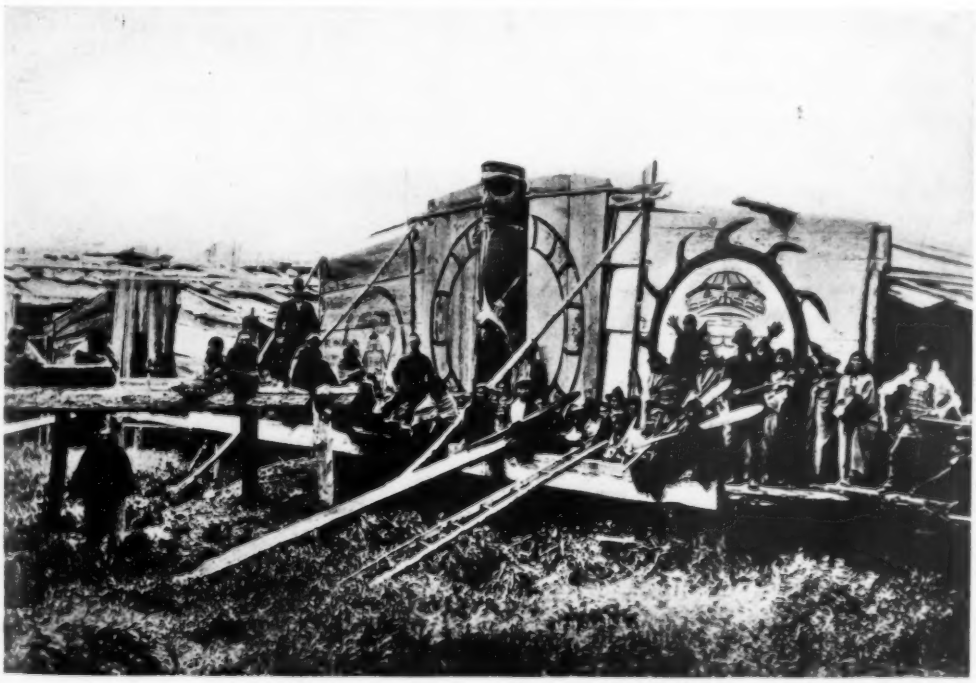
OLD HOUSE OF THE NORTHERN KWAKIUTL

Over the doorway is painted a raven, and a raven figure in profile is on either side. The photograph was taken in 1889 at the deserted village of Kitasoo, Klemto Pass, British Columbia

Photograph by Maynard

A LOST LANDMARK OF SKIDGATE

The frame of Captain Gold's house on Queen Charlotte Islands stood from 1895 to 1900, but had entirely disappeared by 1912. The front of the house bore the painting of a hawk



IN THE BELLA COOLA DISTRICT

In 1902 there were no signs remaining of these houses at Kimsquit, British Columbia. The photograph was obtained from the late Doctor Powell, superintendent of Indian Agencies

CHARACTERISTIC ART OF THE NORTHWEST COAST
The central figure represents the Wolf sitting up. On either side is a yong wolf in profile. Above is a cliff and below is a stream. 1898

recurved bill at the point. The Tlingit of Alaska consider the osprey, "hahtle," as typical. "Hai-et-lik" is shown in carving and painting as a snake's body with an abnormally large wolflike head, with a characteristic pointed hook-shaped ear, and extended red tongue.

Swan, in *The Indians of Cape Flattery*, says:

> This mythological being is supposed by them to be a gigantic Indian, named, in the various dialects of the coast tribes Ka-kaitch, T'hlu-kluts, and Tu-tutsh, the latter being the Nootkan name. This giant lives on the highest mountains, and his food consists of whales. When he is in want of food, he puts on a garment consisting of a bird's head, a pair of immense wings, and a feather covering for his body. Around his waist he ties the ha-hek-to-ak or lightning fish, which bears some faint resemblance to the sea horse (*hippocampus*). This animal has a head as sharp as a knife, and a red tongue which makes the fire, The Thlu-kluts, having arrayed himself, spreads his wings and sails over the ocean till he sees a whale. This he kills by darting the ha-hek-to-ak down into its body, which he then seizes in his powerful claws and carries away into the mountains to eat at his leisure.

There are two paintings in the American Museum on old native split and adzed cedar boards, about 10 feet long, 6 feet high and 1 inch thick, which date back well into the middle of the last century. They were in Chief Quan-tough's house at Moohoulth, the principal village of the Opitchesaht, at the confluence of the Sproat and Somass rivers, beyond Alberni on Vancouver Island, which has long since been abandoned. These descended through Sin-set to Ta-tooch, whose description and story is here given. They stood against the wall at the back of the house where the chief

AN INTERIOR SCREEN
Painting on boards in the back of a house of the "Kos-ke-di" family at Sitka, Alaska, representing the legend of the Raven Creator and a shaman's medicine bowlder. 1898

and his family lived, and at potlatches and on important family occasions they were brought out and displayed. They are very finely chiselled over the front, which has been rubbed over with crushed salmon egg and oil and painted in black (charcoal ground with salmon egg and oil) and red (salmon egg and color from alder or hemlock bark). Each picture represents the fabulous Thunder Bird "Took-su-quin" with outstretched wings just rising in flight with a whale in his talons. On one side is the Lightning Snake "Hai-et-lik" and on the other side the Wolf, "Ka-natle," all of which are brought into the family story as given by Tatooch, the owner of the paintings and a direct descendant.

HOUSE CREST REPRESENTING A HALIBUT
Painting on the front of a "Na hut de" family house at Saxman, a "Sonnah Kwan" (Cape Fox tribe) village on Tangass Narrows in 1889

In the early part of the summer, many many years ago, when the His-set or Sockeye Salmon were seeking their spawning ground in Sproat Lake, Klee-Coot Sin-set, a chief of the Opitichesahts, went to visit his fish traps at Too-whilth. This is the name given by the Indians to the falls on the Sproat River over which the salmon had to pass on their way to Sproat Lake. It was the most formidable obstacle they had to overcome, and it was here that the Indians built their traps in order to capture the salmon.

AN EAGLE HOUSE CREST
In the collection of A. C. Bossom, Esq., London, England, is this carved painting on a cedar plank partition from an old Haida House, Howkan, Long Island, Southeastern Alaska

The trap was a primitive affair made of a basket woven with strips of cedar and bound together with cherry bark. It was tied to a log placed across the river for that purpose. Immediately over the falls, where it was necessary for the salmon to jump clear of the water in order to continue their journey up stream, numbers of salmon would fail to clear the brink

A RECORD FOR FUTURE GENERATIONS

Sin-set portrayed his experiences on two cedar boards. One of his descendants, Tatooch, inherited these paintings

THE EAGLE HEADDRESS

(The Thunder Bird)

Chief Joseph John of the Nootka tribe, in ceremonial dress at Tofino, west Coast of Vancouver Island, British Columbia

KILLER WHALE CREST

Painting representing a killer whale pursuing a hair seal (its natural food) on a "Duck-clar-way de" family house at the "Hootz-na-ho" village of Angooan, Admiralty Island, Southeastern Alaska

卐

CHARACTERS IN SIN-SET'S ADVENTURE

The Thunder Bird is shown with the whale in his talons. On one side is the Lightning Snake, and on the other is the Wolf

of the falls in their jump and would fall back into the basket. The whole structure was very primitive and shaky, and in walking on it to gather his catch, Sin-set lost his balance and fell into the river. Down he went over the falls, at the foot of which there is a large, deep hole or pool.

When Sin-set got into the hole, he saw two whales. They came swimming to him and called him by name, then disappeared. They returned in a short time and said to him,

"Sin-set, Sin-set, follow us."

He did so, and after quite a journey, came to a place called Moo-houlth on the Stamp River, which once was a large village. Here the whales left Sin-set, telling him they would be back shortly. When they did return, they had with them two beautiful young women named Ohk-sis and Pay-tles, who were formed like mermaids, each with a shark's tail. Sin-set wanted them to run away with him, but they would not do so. They said they would come every day to swim there and would meet him, when he could have all the fun he wanted, but he must be in the water and no one would know of their meeting.

Sin-set agreed to this suggestion and, next day, when the women came to bathe, Sin-set caught the two of them in his arms and took them up the river and into the Lake. He crossed this, and came up on the far side. When he reached the far shore he heard the Thunder Bird "Took-su-quin" making a noise like thunder and calling him by name "Sin-set, Sin-set" and the two girls "Ohk-sis and Pay-tles." The Thunder Bird "Took-su-quin" directed the three of them to go to "Kanatle," the Wolf's house and ask for something to eat. This the three of them did, and, while they were in the house, they heard someone say

"Ah kathlah has sue," "What do you people want?"

They could see no one anywhere. Sin-set began to look around and examine the interior of the house, and upon turning around, discovered that the two girls had disappeared. He then realized that he had come back to life and that he was alone in the house. "Too-su-quin" and "Hi-ee-tlick," the Serpent, appeared and told Sin-set they knew where there was a whale "Eah-toop" in the lake. "Hi-ee-tlick" said he would get "Too-su-quin" to go out and watch until the whale came to the surface, when he could tear a piece out of "Eah-toop's" back and bring it to Sin-set to eat, as he must be hungry. Sin-set then returned to his people. He related his experiences and later portrayed them in his own peculiar way on the boards in order to preserve them for future generations.

This, in brief, is the history of the two fine painted boards now in the American Museum collection.

THE MOUND BUILDERS

The Story of the Builders of the Ancient Mounds and Earthworks of the Eastern United States, as Revealed by the Pick and Shovel of the Archæologist

IN TWO PARTS—PART I

By H. C. SHETRONE
Director, The Ohio State Museum

YOU are motoring along the smooth highway, indulging your liking for the great out-of-doors. Just ahead looms a sign:

MOUND BUILDERS PARK

Curiosity aroused, you come to a stop. Within the Park confines you see a miniature hill; it reminds you of a gigantic chocolate-drop. You step nearer to read the smaller print on the tablet.

BENEATH THIS ANCIENT TOMB THERE REPOSE THE BONES OF SOME CHIEFTAIN OF THE MOUND BUILDERS—THOSE "FIRST AMERICANS" WHO, IN THE LONG AGO WERE PROUD MONARCHS OF THIS LAND WHICH WE NOW CALL OUR LAND.

"But," you ask yourself, "who were the Mound Builders?" Perhaps you have some hazy idea as to what the answer may be; in all probability you have heard the query answered in several conflicting ways. Stimulated by the concrete reminder furnished by the Mound, you determine to find enlightenment, here and now.

"Who were the Mound Builders?" you ask the plowman in the field near by.

"Well, I guess nobody knows," he replies. "My great-grandfather settled this land when there still were Indians here. That Mound, even then, had big trees growing on it, and the Indians knew nothing about it."

Appealing to the filling station attendant at the edge of the village, you elicit this response:

"They call them Indian Mounds, so I guess they must have been built by the Indians."

The village patriarch, however, ventures to disagree. "The Mound Builders," he asserts, "remain an unsolved mystery. They were a different race from the Indians. They were highly civilized, had great cities, and were ruled over by despots who enslaved their people. When I was a boy, my father plowed out from a Mound a skeleton that measured eight feet high. It was double-jointed, and had double jaw teeth all the way round."

"Verily," you conclude, "I must seek the answer to this riddle elsewhere."

Perhaps no phase of human history holds more of human interest than that

HUMAN EFFIGY TOBACCO PIPE

The head-dress of this tublar pipe forms the mouthpiece, while the bowl is beneath the feet. The specimen was found by Dr. W. C. Mills in the Adena Mound, Ross County, Ohio

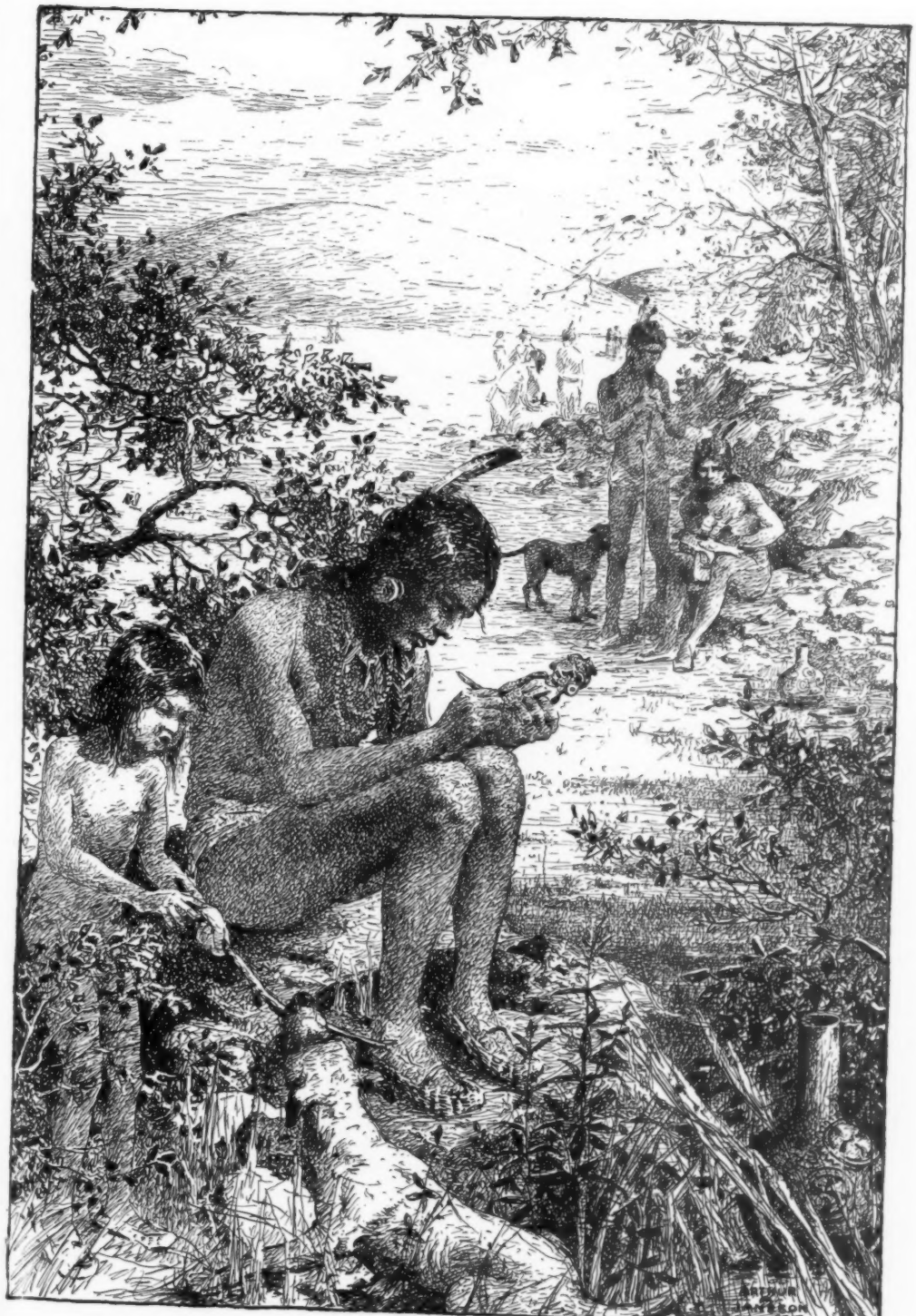
centering in the so-called Mound Builders. This is due in great part to the antiquity and mystery attributed to the subject, and to its romantic setting. Again, no other subject affords so fertile a theme for surmise, speculation, and fanciful theorizing. From the earliest colonization of the Mound region there has been an irresistible tendency to create an epic of an unknown people living in an unknown world of the long ago. Such illustrious persons as Thomas Jefferson of Virginia and William Henry Harrison of Ohio fell under its spell. Jefferson has been referred to as the first actual explorer of the Mounds, the scene of his activities being along the Rappahannock of his native state. Harrison, of log cabin fame, was equally active and even more eloquent in discussing the fascinating theme as it applied to his immediate territory. Each set a high goal for ambitious archæologists, by first digging Mounds and then becoming President of the United States!

Jefferson and Harrison may be said to have crystallized two early schools of thought as regards the Mound Builders—Jefferson, the cool, calculating type, reaching no conclusions except those based upon material evidence; and Harrison, permitting his fancy to picture a race and a civilization unique from anything to be found in fact. From these early beginnings the controversy flowed through the years, each school with its ardent supporters. Out of it, through individual and institutional effort there has emerged the present-day theory which, while not altogether "provable" enjoys a consensus of opinion on the part of authorities.

But the general public remains unenlightened or at least unconvinced. Who were the Mound Builders? Whence came they, and When? Why did they build Mounds? and What became of them? These five W's of American archæology remain for the average man and woman the same open queries that they were to the pioneers. The reason may be that the average person is accustomed to think in terms of concrete values and thus to demand specific answers, not realizing that in matters of antiquity and prehistory such are not always forthcoming. Again, human nature feels an inherent need for romance, mystery, and magic; and now that science has pushed back the frontiers of Fairyland so far as to leave hardly an unexplored corner for the little people of the imagination, perhaps they feel that their cherished conceptions of the Mound Builders should be retained as a last sanctuary for romantic fancies! At any rate a large percentage of the public, including teachers and educators, continue to ask "Who were the Mound Builders?" And the press, even editorially, echoes the query.

Before attempting to find answers to the questions concerning the Mound Builders, let us examine briefly the material evidences of their culture to determine whether they may be worth considering.

The area of Mound occurrence extends from the headwaters of the Mississippi and the Great Lakes southward to the Gulf, and from the tier of states bordering the Mississippi on the west, eastward into western Pennsylvania and New York and, farther south, to the Atlantic seaboard. Within this area the thousands of tumuli, ranging from hardly perceptible elevations to structures measuring close to 100 feet in height, are a veritable part of its physical geography. In addition to the Mounds proper there are numerous ancient fortifications and ceremonial structures of earth and stone, cemeteries and burial grounds, and other major prehistoric remains. It matters not whether you live in the general Mound area, or elsewhere; these mute evidences of the fact that "Hereabouts



Drawing by Arthur A. Jansson

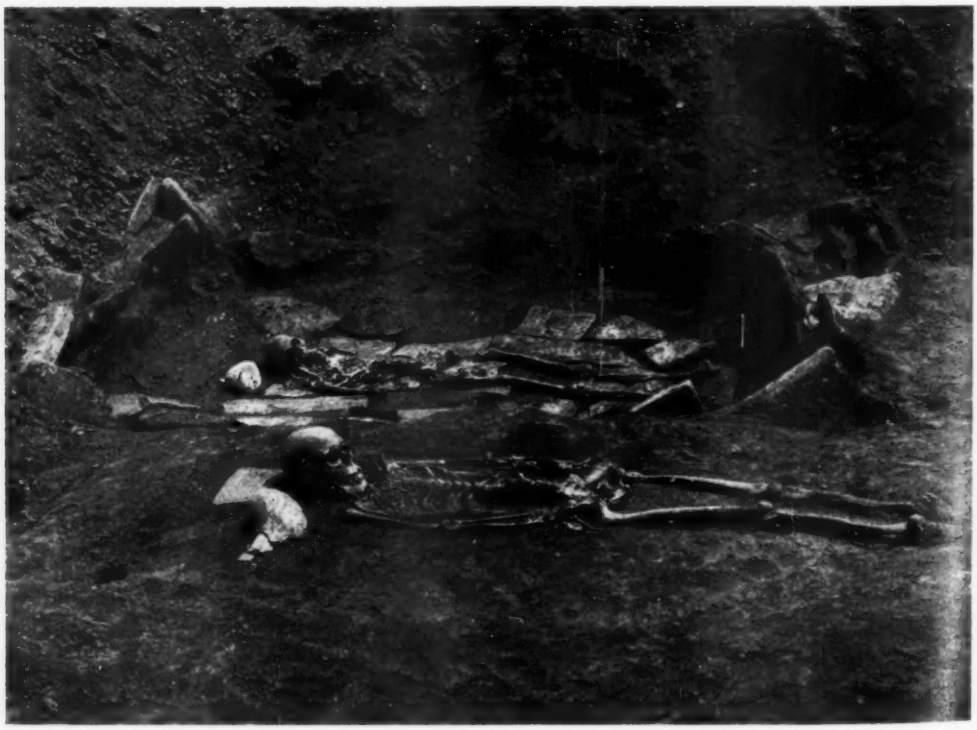
A PREHISTORIC SCULPTOR

Many objects indicative of the high art development to which the Mound Builders attained, have been found associated with their remains in the Mounds which these "First Americans" erected as monuments to their dead. The mystery surrounding these tribes who peopled America centuries prior to the coming of the white man, affords a fertile theme for speculation

Photograph by G. S. Severent *Courtesy of W. K. Moorehead*

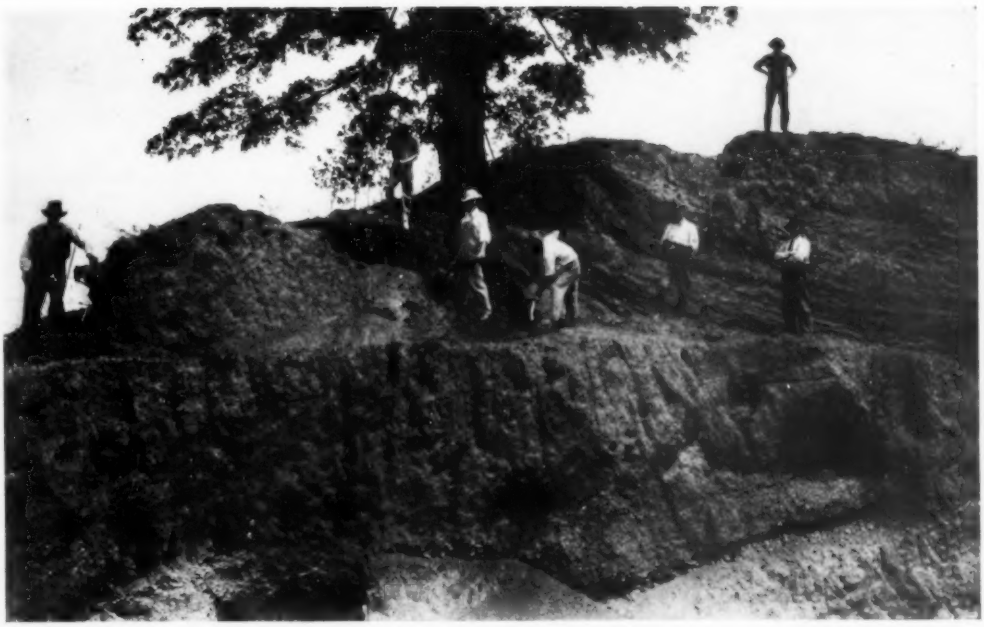
MONK'S MOUND, LOOKING WEST

This great central Mound of the Cahokia Group at East St. Louis, Illinois, is the largest tumulus in the Mound area. It is 100 feet in height and covers 16 acres of ground



A STONE GRAVE BURIAL OF THE HOPEWELL GROUP

The skeleton in the background occupies a pretentious stone grave and is accompanied by numerous implements and ornaments. With the skeleton in the foreground was a large shell container, a copper breastplate, and numerous beads



THE SEIP MOUND, ROSS COUNTY, OHIO

In constructing a charnel-house of logs in this Mound, the aboriginal engineer erred in figuring the stress of the timbers, and the weight of the Mound erected above it caused the structure and Mound to cave in

THE CAVED-IN PRIMARY MOUND

The apex of the Mound was later rebuilt by the primitive workmen. The man in the picture is standing upon the caved-in structure, and the restored apex is immediately behind his shoulders

men used to live and die" is a perennial source of interest, especially to the traveler, tourist, and vacationist.

In the region of the Upper Mississippi Valley, particularly in Wisconsin and contiguous territory, there occur numerous so-called effigy Mounds, constructed in the images of birds, animals, and the human form. As with the commoner type of Mounds, conical in shape, these contain human burials; further, they are supposed to represent the animals and birds which, in life, served their builders as totems.

Passing southward into the lower Mississippi valley, the interesting platform Mounds, flat-topped, in the form of truncated pyramids, and indicating a different and distinct "culture" of Mound Builders, are everywhere in evidence. These truncated Mounds usually are placed at the center of a group of lesser Mounds, themselves often conical burial tumuli. The group as a whole marks the site of an ancient Mound-Builder town or settlement, as evidenced by surface débris resulting from domestic activities. Exploration reveals that the flat-topped structures, often of considerable areas, served as platforms or foundations for houses, temples, and sacred structures, and as refuges in time of high waters. Burials, if they occur, are confined to the upper levels, where interments were made on or below the floors of dwellings. During the recent great flood of the Mississippi, these elevations were in some instances the only places of refuge for the inhabitants over a wide area. Throughout the great valley, subject to frequent inundation, they are preserved by farmers as places of refuge, both for humans and for live stock.

Strangely enough, the most northerly presentation of the great flat-topped Mounds, the noted Cahokia group at

EAGLE EFFIGY PIPE

Tobacco pipes were carved in effigies of birds, animals, and human beings. This example was found in the Tremper Mound at Scioto County, Ohio

East St. Louis, Illinois, is at the same time the largest and most impressive of the entire area. The Cahokia group comprises more than eighty tumuli, a number of which are exceptionally large. The central Mound of the group, known as Monk's Mound, is one hundred feet in height and covers sixteen acres of ground. The labor necessary to construct this group under primitive conditions, with nothing better in the way of equipment than rude digging sticks, clam-shell hoes, and simple carrying baskets, affords some idea of the stupendous task of erecting the many thousands of Mounds and earthworks in the general area. The lower Mississippi region, with its many truncated Mounds, is further noted for the high development of its fictile art. Hundreds and thousands of pottery vessels of elaborate forms and decorations have accrued from exploration of its burial mounds and cemeteries. The art development of the region likewise is of a high order.

POTTERY WARE FROM SOUTHERN MISSOURI
Crosses, swastikas, and cosmic designs decorate this painted vase (Holmes, Bureau of American Ethnology)

Throughout the Tennessee-Cumberland valleys a similar and equally high cultural development is found. Flat-topped Mounds are still in evidence but less abundant, while stone-grave cemeteries are a characteristic feature, and art attainment is of a high order. The outstanding site of this region, particularly as regards artistic development, is the noted Etowah Group, near Cartersville, in northern Georgia. Southward through Georgia, the Carolinas, and Florida, other interesting and scarcely less important cultures are found.

Perhaps the highest cultural development of the entire Mound area occurs in the southern half of Ohio and in contiguous territory. Here the so-called Hopewell culture of Mound-building peoples constructed ceremonial earthworks in geometric forms and carried their artistic attainments to a degree of perfection unequalled in America north of Mexico.

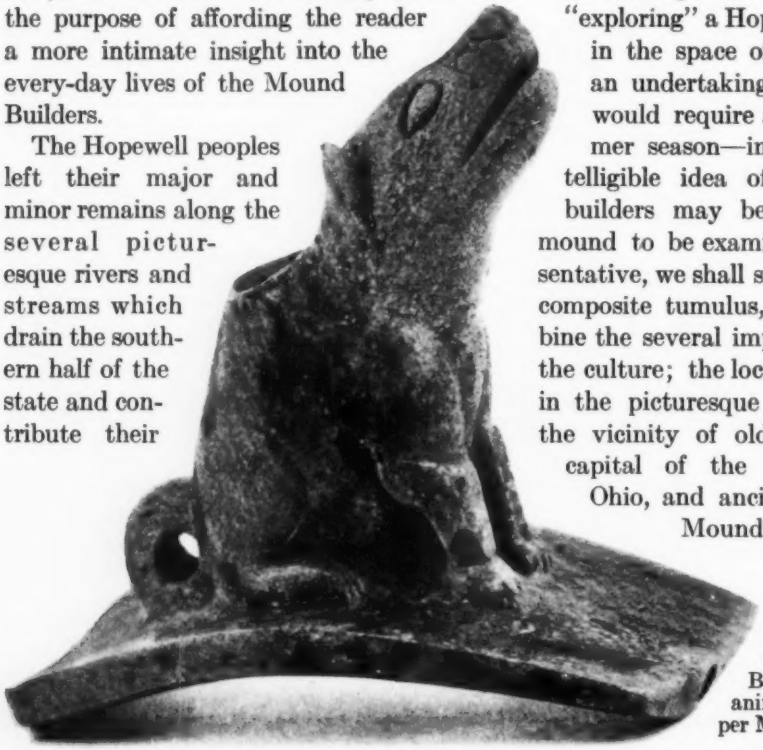
From this brief survey it will be noted that the Mound Builders were by no means a homogeneous people. Numerous cultures or kinds, some of them comparatively simple and others highly evolved, were comprised in the Mound Builder complex. As an illustration, it may be pointed out that in Ohio alone some half-dozen distinct cultures have been identified by their archæological remains. Of

these, that known as the Fort Ancient, or Madisonville, is particularly impressive, not on the basis of high development, but because they were widely distributed, populous, and evidently a most representative and self-sufficient people. They take their name from the ancient fortification—Fort Ancient, in Warren County—the most important prehistoric redoubt in the Mound area, although it is not certain that they constructed it; and from the extensive prehistoric village- and burial-site located near Madisonville, Hamilton County. Their culture is characterized by extensive habitation sites, indicating a sedentary agricultural existence, and by the presence in connection therewith of numerous conical burial Mounds.

Although the Hopewell culture of Ohio, as noted above represented the maximum cultural attainment of the Mound area and therefore is hardly representative, it will serve as well as any other the purpose of affording the reader a more intimate insight into the every-day lives of the Mound Builders.

The Hopewell peoples left their major and minor remains along the several picturesque rivers and streams which drain the southern half of the state and contribute their waters to the Ohio River. Most striking of their contributions to archæology are the impressive ceremonial earthworks, constructed of earth in the form of geometric figures—squares, circles, crescents, octagons, and so forth. These, occurring singly or in combination, enclose areas ranging from one acre or less to as much as one hundred acres, and are supposed to have served social or religious purposes. Accompanying them, within or adjacent to the earthen enclosures, are burial mounds, usually in groups of from two to thirty or more.

Detailed examination of a Hopewell group is most fascinating. Only the merest suggestion of the procedure can be given here; sufficient, it is hoped, to encourage the reader to examine more closely the mute evidences of the lives of these interesting prehistoric peoples, and the careers of the numerous other cultures throughout the Mound area. Let us attempt the difficult task of "exploring" a Hopewell mound within the space of a few minutes—an undertaking which, in reality, would require at least a full summer season—in order that an intelligible idea of the lives of its builders may be had. That the mound to be examined may be representative, we shall select an imaginary, composite tumulus, which may combine the several important features of the culture; the location, let us say, is in the picturesque Scioto Valley, in the vicinity of old Chillicothe, first capital of the commonwealth of Ohio, and ancient capital of the Mound Builder "empire."



AN ANIMAL EFFIGY PIPE
Made in the image of a dog — the Mound Builders' only domestic animal. From the Tremper Mound, Scioto County, Ohio

A COPPER BREASTPLATE
From the Mound City Group, Ross County, Ohio

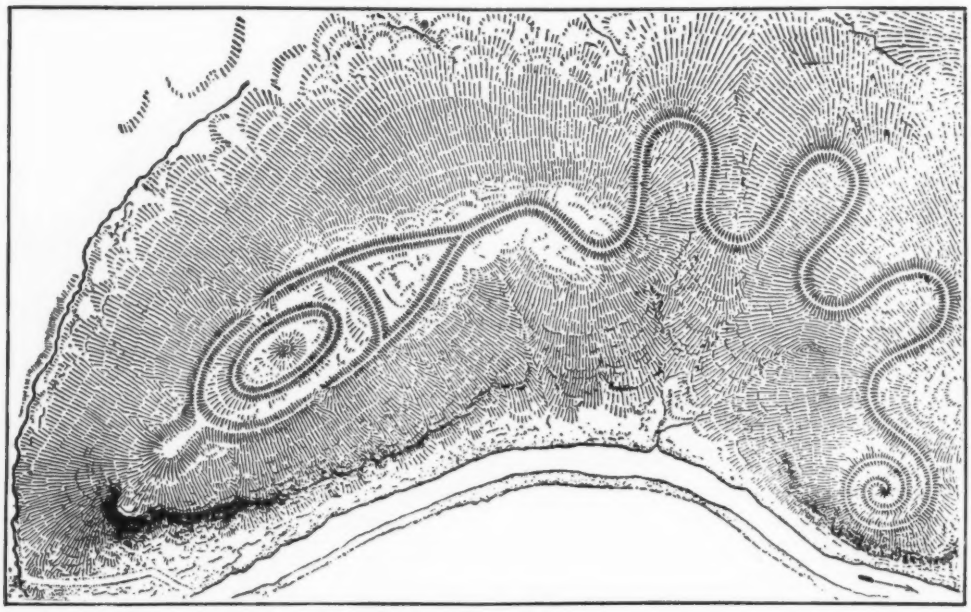
Before us stands an imposing artificial hillock, in form intermediate between a cone and a hemisphere. It is approximately one hundred feet in diameter at the base and twenty-five feet in height. The field in which it stands is under cultivation, but the Mound itself, being too precipitous for farming purposes, is covered by a thicket of vegetable growth. Accentuating this are several well grown trees. The fallen remains of other trees, in ultimate decay, attest the antiquity of the Mound. An exploration party has just arrived on the scene preparatory to examination of the ancient tumulus. We secure permission to tarry awhile as interested observers. We ask innumerable questions and receive replies, although we note that these answers are terse and without elaboration. Questioning apparently has become an old story, and a somewhat tiresome one to the archæologist in charge.

A party of workmen with picks and shovels step to the edge of the Mound and begin to dig, throwing the loose earth well behind them. The "boss" explains the plan of attack. The entire mound, to the last cubic foot, is to be removed. It will be sliced off, as a cake might be, in five-foot sections, as deep as there is any evidence of artificial construction or disturbance. Surveying instruments, cameras, note-books, everything in readiness. Teams and scrapers waiting, too; for disposal of the dislodged earth, once examined, will be a problem in a mound of this height. An eight-foot working trench must be kept clear at all times.

The first of the five-foot slices having been removed, there appears, at the level of the surrounding field, what looks to the uninitiated like a cement floor. At the outer edge of this, and apparently following the marginal curve of the mound, appear post-holes, a foot or two apart, some of which still contain evidences of decayed posts. These phenomena, we are informed, are significant and gratifying to the explorer. They prove beyond doubt that his "diagnosis" was correct; the mound is definitely of the Hopewell culture, and doubtless will yield many things of interest.

"And why the floor and the post-molds?" we inquire. The explanation is as follows:

"When a Hopewell culture band or tribe picked a site for a new home, one of the first and most important things they did was to set aside a spot for the erection of a sacred structure—their temple, we might say. Clearing this spot of trees and brush, and even the loose top soil, they set posts into the ground, to form the walls of a circular or oval enclosed structure. Twigs and clay then were used as wattlework to render the walls more or less weatherproof. All or part of the structure was given a roof of thatch. Clay was plastered over the floor, and an inch or more of sand or gravel strewn on this as a floor covering; and lo! a sacred temple, for social, religious, and funeral purposes. Into this structure they brought their dead for the funeral ceremonies and for interment.



MAP OF THE GREAT SERPENT MOUND
From a survey made by Prof. W. H. Holmes for the Bureau of American Ethnology

The building corresponded closely in usage to the pioneer church and attendant graveyard; the Mound Builders, however buried their dead right in the church—a primitive Westminster Abbey! The structures at times are partitioned off into two or more rooms, sometimes as many as five. One may be the audience room or chapel; another, a room where the dead were cremated; a third, the compartment in which the deceased were buried; still another, a shrine room, where offerings of cherished possessions were made to the deities—the Mound Builders' method of making sacrifices."

Our attention is suddenly called to the actual work at hand. A laborer has struck his mattock into a loose spot in the face of the Mound.

"That will be a burial," the boss remarks.

And sure enough, within an hour a human skeleton lies there on the floor of the mound, all cleared off and ready to have its picture taken. "The Hopewell people," we learn, "placed their dead on rectangular earthen platforms, raised a few inches above the floor of the sacred structure. Over them they built cabin-like structures of logs, and covered these, in turn, with small primary mounds of earth. The decay of the timber structures resulted in the dropping down of the earth above them, leaving loose open arched spaces."

"But you mentioned cremation," we remind him. A second burial, a few feet removed, seems in every way like the first, excepting that instead of a skeleton there is merely a "hatful" of fragments of bone.

"Here is your cremated burial," we are informed.

And in due time there is uncovered a carefully formed rectangular basin, shaped something like an old fashioned cement horse trough, built upon and extending into the floor. It, like the floor itself, is of clay, burned to the hardness and color of soft brick.

"And here's the basin in which the body was cremated. About 70 per cent

of the Hopewell burials so far unearthed have been cremated." We have thought of cremation being an innovation—something new!

The two burials so far unearthed have had little or nothing in the way of "relics"; they apparently were just "poor folks." But now comes a third. According to the authority, it promises to be a good one; the grave is large and pretentious. It proves to be a double burial, containing the skeletons of a male and a female—both young. Royalty, they must have been, judging from the barbaric splendor of their funeral dower. Helmet-shaped head-dresses of copper; breast-ornaments, beads and bracelets of the same metal; spool-shaped ear ornaments of copper, covered with thin silver foil; hundreds, yes, thousands, of fresh-water pearl beads; and remnants of a burial shroud of woven fabric, with colored designs, preserved by the chemical action of the copper breast-plate. Things are coming fast. The workmen have found another burial. This time, that of an old male; possibly a shaman, medicine man, or chief. In addition to ear ornaments, copper head-dress, and bear-teeth necklace, he is accompanied by a large copper axe and large spearheads chipped from obsidian or volcanic glass. A section of a human femur is engraved with an amazingly intricate and beautifully executed conventional design, while other designs are executed in repoussé and scroll from thin sheets of copper.

From what we have seen we try desperately to reconstruct the lives of those long-gone Mound Builders whose mortal remains we have viewed. It isn't until lunch time, however, that we succeed in getting the archæologist to symphathize with our enthusiastic search for knowledge.

"The graves you saw uncovered give a pretty fair idea of what their occupants

SERPENT MOUND PARK

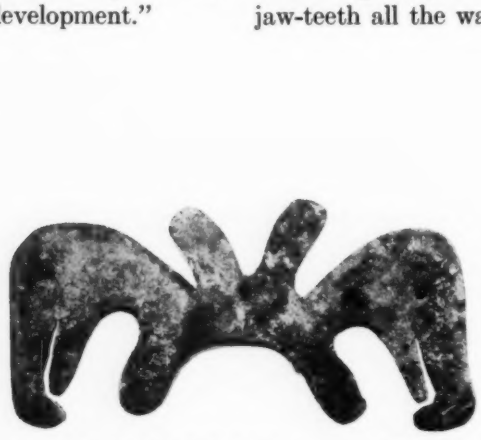
A view of the anterior portion of the great serpent, looking toward the head. The men at the extreme right furnish a scale for judging the size of this greatest of all effigy earthworks. Photograph by B. E. Kelley

were like" he comments. "Of course we find many other things besides the relics with those three interments. They made artistic pottery ware, wove good fabric from fibers and bast; worked stone, flint, bone, shell, wood, copper, silver, and meteoric iron into implements, ornaments, and utensils. The copper and silver they secured from the Lake Superior copper region. They hadn't learned to melt it, but treated it as malleable stone, hammering and grinding it into form. They had many materials from distant sources of supply, as obsidian and grizzly-bear canines from the Rocky Mountain district; lead ore from Illinois; copper from northern Michigan; mica, quartz, and other minerals from the Lower Alleghenies; marine shells from the Gulf of Mexico. They secured these things by trade or by sending out expeditions; probably both. They must have spent a great deal of time in gathering mussels from the streams in order to secure the thousands of pearls they possessed. Pearls were a mania with them. Their artistic development is almost incredible. Yet they never advanced beyond the Stone Age period of development."

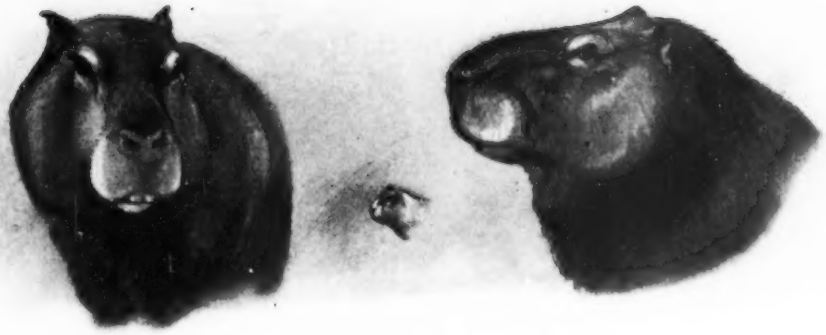
"And where did they live? Do you find the remains of their houses?"

"Like the ancient Mexicans, the Hopewell peoples and some others of the Mound Builders gave most of their attention to the dead rather than to the living. The Pueblo- and Cliff-dwellers built for the living, burying their dead, if at all, in the quickest and easiest manner. The Mound Builders built mainly for the dead. Adjacent to the Mounds we find their village or town sites, but the only evidences of dwellings are the post-molds and fireplaces showing where rude huts or tipis have stood. They were agricultural, raising maize, squash, beans, and tobacco; but they depended much on fish and on game secured in the chase."

In response to the inquiry as to what could be determined from the skeletal remains found in the Mounds, we learn that the physical anthropologist finds them to have been not strikingly dissimilar to the historic Indians, nor very different from the present-day inhabitants in so far as size or stature is concerned. One thing we can see for ourselves; they were not giants, nor did they have double jaw-teeth all the way round.



Double-headed bird design in copper. From the Mound City Group, Ross County, Ohio



Restoration of extinct capybara, compared with its living relative the guinea-pig

RODENT GIANTS

The Sizes of Living Gnawing Animals from Tiny Mice to Giant Capybaras—Extinct Rodents as Large as Bears and Hippopotamuses

By GEORGE GAYLORD SIMPSON

Associate Curator of Vertebrate Palæontology, American Museum

With Two Restorations and One Sketch by E. Rungius Fulda

RODENTS help to clothe, to feed, to amuse, to annoy, and sometimes to kill us. The humble rabbit furnishes hair for our felt hats and also appears on our tables in succulent (even if not universally appreciated) dishes. In its many disguises the pelt of this rodent provides us with furs, and the true beaver, muskrat, chinchilla, nutria, squirrel, and marmot are all rodents. The frisky squirrels, enlivening parks and forests, the gophers and woodchucks, detested by farmers, and the mice and rats, bane of the housewife, are all rodents. Rodents live in almost all situations, from salt marsh to mountain top, in all climates from the Equator to the Arctic, and in all parts of the earth from New York to Timbuctoo. Everyone knows something about them, for they are among the most widespread of creatures, and their varied ranks include some of the most harmful and some of the most useful of animals.

What part do rodents play in nature? They have enlarged front teeth and are gnawing animals; that is what the word "rodent" means. Most of them live on vegetable food. Most of them are small. It almost seems as if the rodents had a sort of working agreement with that other great group of vegetarians, the hoofed mammals, or ungulates, for the rodents are the small plant-feeders and the ungulates are the large. The living rodents range in length from three or four inches to more than three feet, with the great majority less than one foot, while living ungulates are from less than two feet to about twenty feet in length, with the majority well over three feet.

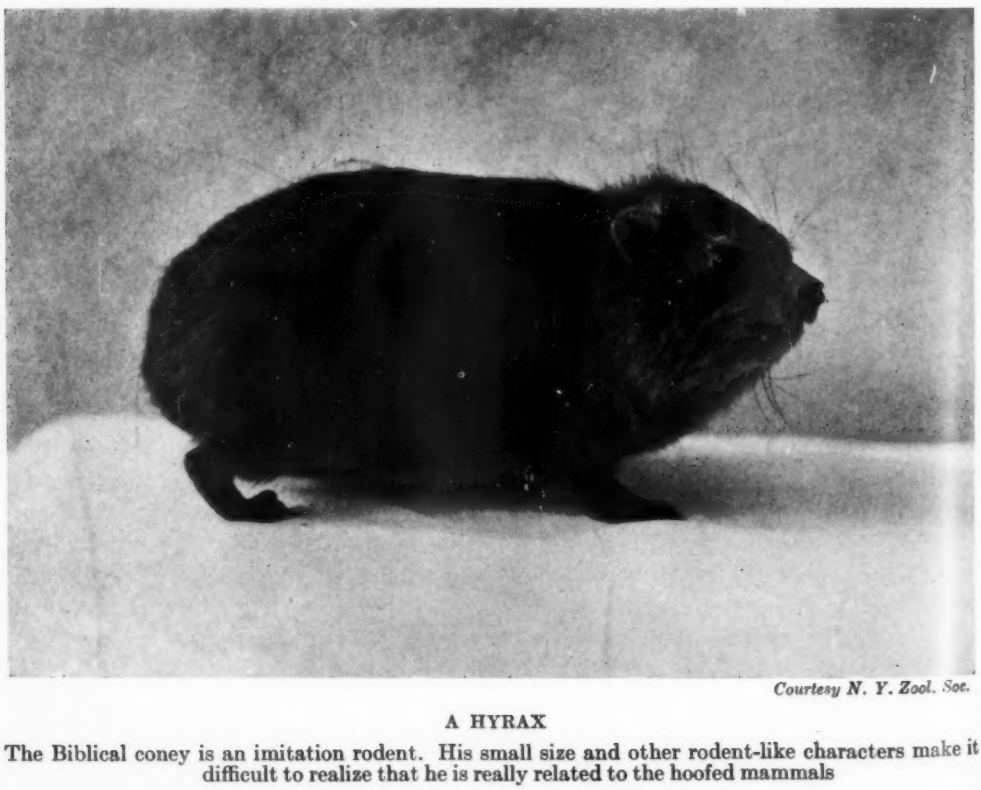
This rule of size is not too strictly observed, to be sure. The hyraxes or coneys, "feeble folk" of the Bible, are smaller than many rodents. They look much like rodents, too; some of them climb trees, and they even have gnawing teeth, but they have hoofs and their anatomy clearly shows that they are not rodents at all but a queer sort of ungulates. They are imitation rodents. In size, appearance, and habits they stand at one end of the great series of hoofed mammals which has such forms as the elephant at the other end, and our familiar pigs, sheep, cows, horses, and many wild animals somewhere in between.

In our country most of the rodents are small. The jack rabbit, woodchuck, porcupine, and beaver are the largest. The beaver, our giant among rodents, is sometimes about as large as our smallest hoofed mammal, the peccary (so-called "wild pig") of Texas and Arizona. In South America there are rodents even larger than the beaver.

South America, once totally distinct from any other part of the world in its animal life, still has many peculiar forms, including a whole series of strange and often very large rodents. Among them is that well known and long suffering servant of science, the guinea-pig (so-called, as someone has said, because it does not come from Guinea and is not a pig) and so is the chinchilla, the name of which is used more often than the fur. Other South American rodents are little known even by name, yet at least one of them is certainly worthy of lasting fame: the capybara or carpincho.

The capybara is the largest living rodent. Its length often exceeds three feet (although the tail is insignificant) and the weight may be more than one hundred pounds—a true giant when compared with its close relative the guinea pig, not to mention the tiny field mice and other more distant allies. It lives throughout most of the watered parts of South America east of the Andes, an enormous area, and is very abundant in some regions. Neither the hide nor the flesh is greatly prized by man, but the jaguar of its native haunts is less particular and takes heavy toll.

Darwin visited the home of the capybara during the voyage of the "Beagle" in 1832 (at the age of twenty-three) and has left a vivid account of this curious beast.



Courtesy N. Y. Zool. Soc.

A HYRAX

The Biblical coney is an imitation rodent. His small size and other rodent-like characters make it difficult to realize that he is really related to the hoofed mammals

RESTORATION OF EXTINCT GIANT BEAVERS

These great rodents, *Castoroides*, were as large as bears and were widespread in North America during the Ice Age. The scale is given by comparison with a more familiar rodent, a squirrel, on the tree in the foreground

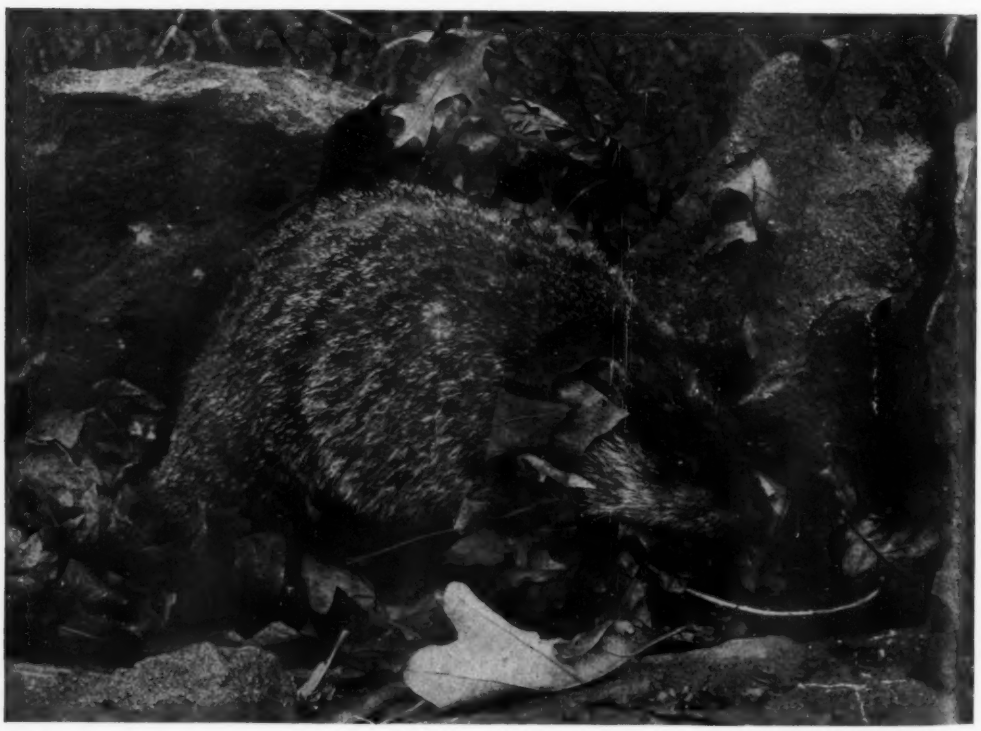
"These great Rodents," he wrote, "occasionally frequent the mouth of the Plata, where the water is quite salt, but are far more abundant on the borders of fresh-water lakes and rivers . . . when viewed at a distance, from their manner of walking and color they resemble pigs: but when seated on their haunches, and attentively watching any object with one eye, they re-assume the appearance of their congeners, cavies and rabbits. Both the front and side view of their head has quite a ludicrous aspect, from the great depth of their jaw. These animals, at Maldonado, were very tame; by cautiously walking, I approached within three yards of four old ones. . . . As I approached nearer and nearer they frequently made their peculiar noise, which is a low abrupt grunt, not having much actual sound, but rather arising from the sudden expulsion of air: the only noise I know at all like it, is the first hoarse bark of a large dog. Having watched the four from almost within arm's length (and they me) for several minutes, they rushed into the water at full gallop with the greatest impetuosity, and emitted at the same time their bark. After diving a short distance they came again to the surface, but only just showed the upper part of their heads. . . . "

With their short ears, small legs, rounded rumps, and stubby tails, capybaras do resemble guinea-pigs, but they are like guinea-pigs of Brobdingnagian proportions and aldermanic portliness and gravity. Their deep jowls and long upper lips give them a vastly superior air, ludicrous in contrast to the undignified hump of their hind quarters. They eat grass, bark, and water plants, and live in groups of from three or four to more than a hundred. Although at home on land,

Courtesy N. Y. Zool. Soc.

VIZCACHA

The vizcacha of South America is a small animal, but is closely related to the largest of all known rodents, the extinct *Megamys*, which reached the size of a rhinoceros



Photograph by M. C. Dickerson

A WOODCHUCK

The woodchuck or ground-hog, one of our largest and best known rodents, is hated by the farmer, in spite of his reputation as a weather prophet

Courtesy N. Y. Zool. Soc.

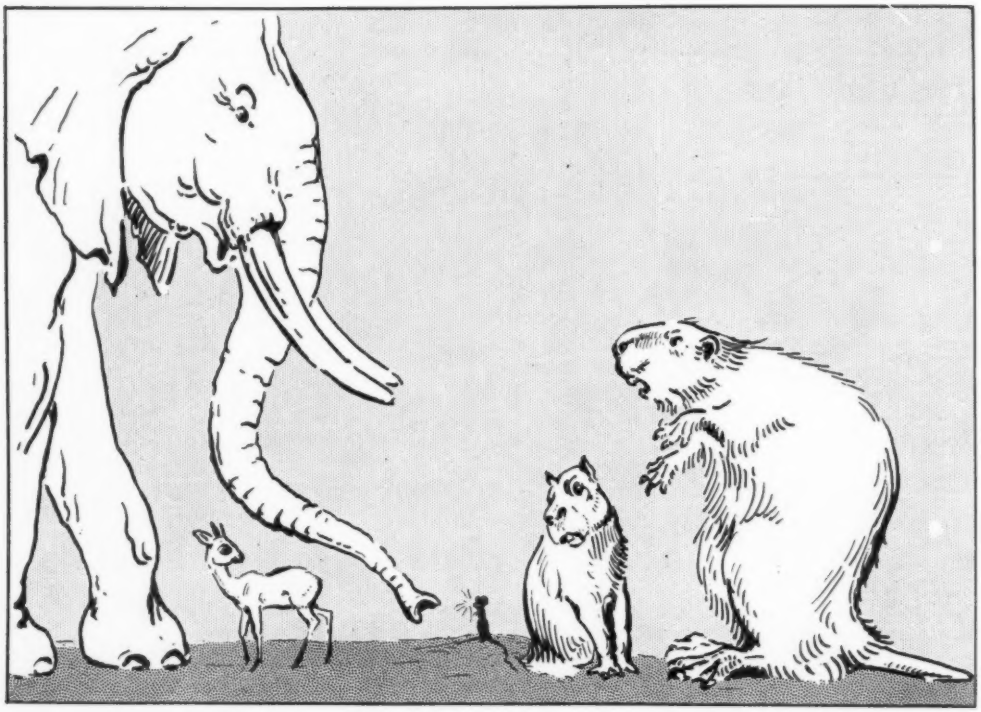
BEAVERS

The beaver, noteworthy for his industry and for his fur, is also the largest of living North American rodents. Individuals weighing nearly seventy pounds have been recorded

Courtesy N. Y. Zool. Soc.

CAPYBARA

The piglike capybara is the largest living rodent, reaching a length of three feet in spite of his very short tail



A STUDY IN SIZE

The elephant and the dik-dik antelope of Africa are near the extremes of size for living hoofed mammals, as the mouse and capybara are for living rodents. The extinct giant beaver towers above his largest living relatives and looks even the lordly elephant in the face

they are usually found near water and are good swimmers. They take to the water when frightened.

Such are the giant rodents of today, but in this group as in so many others, the largest forms are extinct.

The next time you see a mouse, imagine it multiplied in bulk some twenty thousand times. Or when you see a well fed bear at the zoo, think of a guinea-pig of equal size. That will give you some idea of the rodent giants of the past. There were only a few extinct rodents of such great size, for the gnawing animals have always been small for the most part, but these few must have been among the most impressive animals that ever lived.

The very largest of all known rodents is unquestionably that known to scientists as *Megamys*. It might be called a giant vizcacha, for it seems to be related to the living vizcacha of South America, a rodent (closely allied to the chinchilla) not unlike a capybara in general appearance, but very much smaller and with a bushy tail. Bones of this great beast were found in Argentina more than eighty years ago and described by the French naturalist Laurillard, who correctly identified them as parts of a rodent twice as large as a capybara. For years the discovery was discredited, as no one was willing to believe in the existence of such a gigantic rodent. Finally more bone fragments and teeth were found and described, leaving no doubt that Laurillard was correct.

Now several species of *Megamys* are known, and the largest appears to have been about as large as a hippopotamus—strange anomaly in a group that also includes some of the smallest known mam-

mals! Even now not much is known about its appearance in life, except that it probably was something like a gigantic vizcacha. Only fragments and teeth are known, and contrary to the widespread opinion, scientists cannot reconstruct an entire animal from one bone or tooth. The best they can do is to conclude that it probably looked like some better known animal to which the fragments show it to be related. The accuracy of this guess depends on the reality and closeness of the supposed relationship, and it has sometimes fallen very far from the mark. In the present case, relationship to the living form is not close enough to be at all sure that *Megamys* looked very much like a vizcacha, and it must go unrestored until more of its bones have been found.

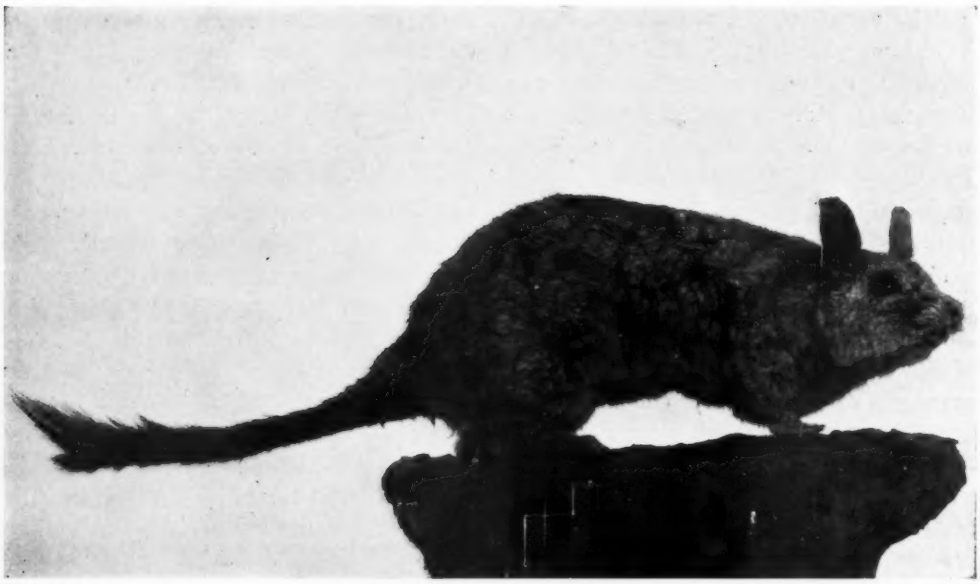
The second of these extinct giants is a North American and it is much better known. This is *Castoroides*, the giant beaver. Its remains were first discovered nearly a hundred years ago and many later discoveries show that it was once very widespread. It was most common in the upper Mississippi Valley, but also occurred throughout the central part of the United States and along the Atlantic coast from Florida to New York. In the far West its remains are rare, but a single occurrence in Oregon shows that it did cross the Rockies. This is a much more recent animal than *Megamys*, as it lived during the Ice Age (Pleistocene) and has apparently not been extinct very long, probably 25,000 years or so and possibly even less.

The recent beaver, now the largest rodent of North America, is always less than four feet in length (including the tail), and is not known to exceed seventy pounds in weight. The extinct giant beaver apparently reached a length of about seven feet and perhaps a weight of some three hundred pounds—a very respectable size and bulk for a modern bear and unheard of among recent rodents. Aside from the size, the most striking thing about the animal was its amazing front teeth. These are large in

Photograph by M. C. Dickerson

JACK RABBIT

Gullible persons from the eastern part of the United States will hear many western stories of jack rabbits as large as donkeys. This is one of our largest and fastest rodents



CHINCHILLA

The little chinchilla of South America has few claims to fame except for his highly prized fur and his relationship with rodent giants

all rodents, but in *Castoroides* they were out of all ordinary proportion. They are about an inch in width and eight inches in length along the outer face, lying in great curved sockets in upper and lower jaws. Only a third or less of the length projected beyond the bone, but (as in all rodents) these teeth grew continuously and could not be worn out. The enamel is corrugated in a peculiar way, so that even a small fragment of the incisor can be identified.

The giant beaver, unlike *Megamys*, is a well known animal. Several complete skulls have been found, and also a large part of the skeleton, so that it is possible to restore the appearance of the living animal. If you imagine a modern beaver multiplied by about two in every dimension except that the tail is not so wide and that the gnawing teeth are not twice but three times as large and are more rounded and furrowed, you will have a fairly accurate idea of the living appearance of this extraordinary beast.

If the habits of the giant beaver were at all like those of the true beaver (and the general structure is sufficiently similar so that there is no reason to believe otherwise) what trees could he not fell with his mighty cutting teeth, and what stream could he not dam! Even the prodigious labors of the modern beaver seem insignificant beside the feats possible to this titan-beaver!

There have been several other large extinct rodents, but only one other type seems truly worthy of the name giant. The giant beaver was a relative of the largest living North American rodent. The third giant is a relative of the largest living rodent of South America; it is a giant capybara. Large capybaras lived in both South and North America, but the occurrence of this animal in the North is most unexpected and interesting.

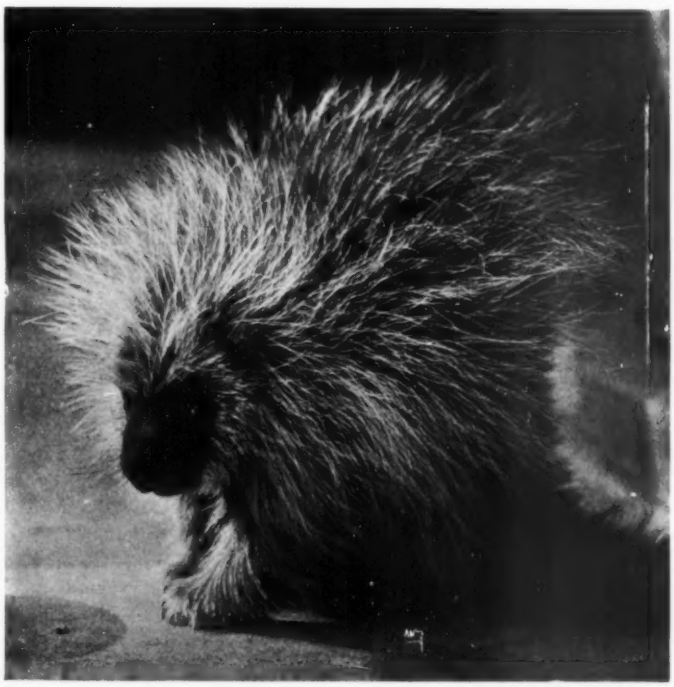
Extinct capybaras have been found in Ice Age deposits in Nicaragua, Texas, South Carolina, and Florida. Capybaras are true South American animals, having

originated there during the long age of isolation. These four occurrences in the northern continent, few as they are, require little imagination to be transformed into a true epic of animal wandering. When the growth of the isthmus of Panama reunited the two continents, the capybaras moved northward, through Nicaragua, into the United States through Texas, eastward to the Atlantic coast, south once more into Florida. Their wanderings covered thousands of miles and must have taken many generations.

There were several species of these northern capybaras. Some were no larger than their recent relative, but one (*Neochœrus pinckneyi*) was gigantic. It was only last year (1929) that enough of this animal was found to show something of its true size and appearance. In a ditch bank near Bradenton (see NATURAL HISTORY, Vol. XXIX, page 511) parts of a skull were found, and study of these parts has made possible a reasonably accurate restoration of the whole skull. (See p. 305.)

The skull is very like that of the living capybara except for its greater size. The differences lie in such technical points as the proportionate width of the skull top or number of plates in the grinding teeth, and, at least to the casual eye, would make no great difference in the appearance of the living animal.

This skull is even longer than that of the giant beaver. The body is not yet known, but it must also have been very bulky, probably quite as much so as that of the giant beaver, although the tail was doubtless very short. In any event, the giant capybara now takes its place as one of the two great giants of the past rodent life of our continent.



Courtesy N. Y. Zool. Soc

A YELLOW-HAIRED PORCUPINE

Beneath his mop of hair the porcupine carries an armament of quills which makes him so nearly immune to attack that he goes] his lumbersome way with an air of conscious superiority

The Beaver Group in the American Museum

THE ACCESSORY MAN AND THE MUSEUM GROUP

How the Setting for a Museum Group is Collected and Prepared

By ALBERT E. BUTLER
Department of Preparation, American Museum

The visitor to the halls of the American Museum is often puzzled when he tries to determine how the grasses and flowers, the trees and leaves and rocks and soil that he sees in the cases with the mounted animals and birds, are collected and prepared. So natural do these appear that it is often difficult to believe that wax and celluloid, plaster of Paris, and paper mache have been utilized in their construction. Furthermore, where one exhibit, as sometimes happens, displays the real with the imitation, it is generally impossible for the observer to tell which is which. In the following article Mr. Butler explains some of the methods used in the preparation of these important "accessories."—THE EDITORS.

THERE are three distinct divisions in the preparation of a museum group,—mounting the animals, painting the background, and creating the foreground with all of its detail of foliage, grasses, and the like.

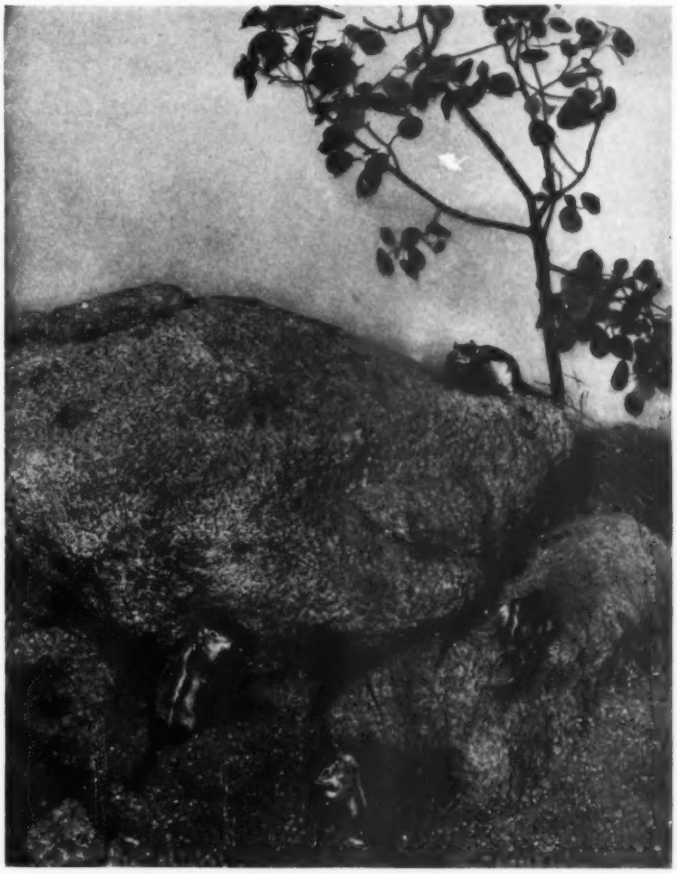
The last-mentioned division is commonly referred to, in museum parlance, as "accessory work."

When an expedition goes afield for the purpose of collecting the necessary material and data to reproduce accurately a background setting for an animal group, an "accessory" man is always included in the personnel. He must possesses a working knowledge of botany, and be an expert in methods of preparation; he must also be able to make all the notes necessary for guidance in reproducing the group material when it reaches the museum laboratories. He must know, when he examines any special plant, the method by which it can best be reproduced. This is a most important point, as there is always a choice of material, and so long as the forms selected are typical of the region, it is better to choose those which lend themselves readily to the ordinary methods and materials used in fabrication. For instance, it would be impractical to select a tiny-leafed acacia bush if there happened to be in the same locality an-

other common bush with large simple leaves. The difference in time and expense saved in reproduction would be amazing, probably as great as ten to one.

The average group usually includes several forms of plant life, possibly a tree trunk with one or more leafy branches, grass, rocks, and surface earth. If a plant form is to be taken, several specimens are chosen for variety of size and form and, while still fresh, are placed in a solution of weak formalin. Extra leaves, in a range of sizes, are selected and carefully packed so as to preserve their original form in the solution. A series of plaster molds is made from other leaves and careful color notes are recorded. If there be flowers, molds or patterns are made from the fresh parts, since these lose their form in the solution. A tree branch is handled in the same manner as are plants, but the trunk may not be taken if it is very large. Usually, all or a goodly sample of the bark, together with numerous photographs from all angles, is sufficient to insure its faithful duplication in the museum workrooms. All branches intended for reproduction are cut apart and carefully strapped in burlap, and are shipped dry. Small grasses are carefully packed in cheesecloth and dropped into solution. Large grasses are packed into snug bundles and strapped with burlap to a board or other stiffener to prevent breakage or other injury during transportation. A few small rocks, sufficient to give variety of shape and color, are taken, but only plaster molds or numerous photographs of large rocks are made, for, obviously, it would be impracticable to attempt to bring back the originals. Usually a sample of earth for color and texture is sufficient, since it can readily be duplicated at home. Silt, dry leaves, sticks, etc. are scooped from the surface in sufficient quantity to cover the ground area of the proposed group. This is quite important, because these include dried parts of much of the vegetation, and if skilfully used, insure a natural finish to the groundwork.

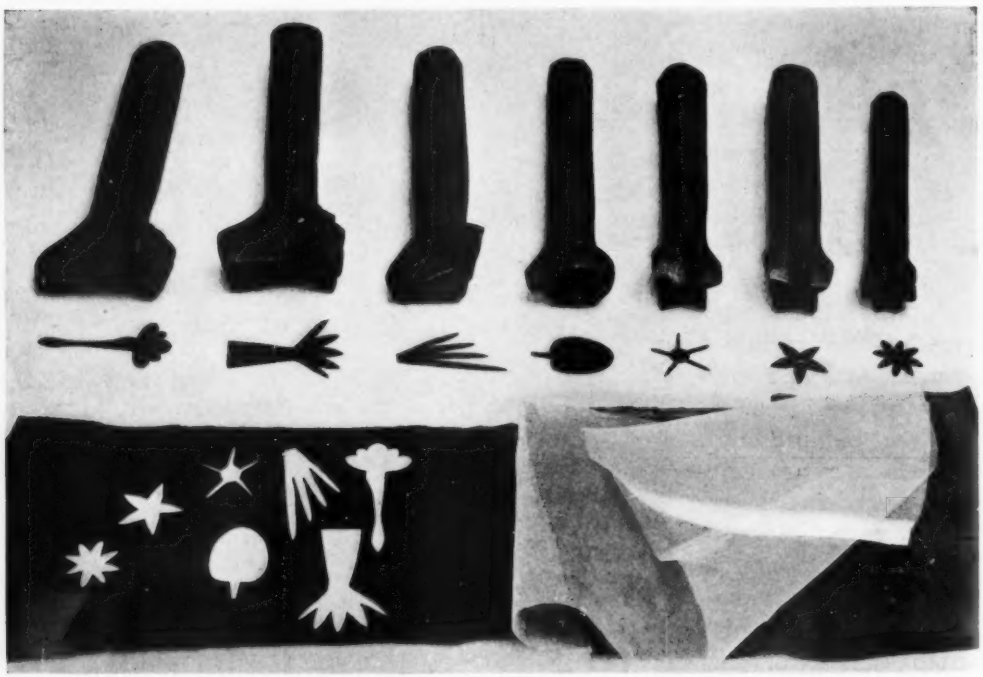
When the collection arrives at the



DETAIL OF THE SAY'S GROUND SQUIRREL GROUP
The "rocks" are modeled in plaster over wire mesh. The small tree is natural, but the leaves are of wax. The grasses are preserved and artificially colored

AN ACCESSORY MAN AT WORK

Mr. Narahara, of the American Museum staff, is here shown engaged in making a flowering shrub, with leaves of wax and flowers of celluloid

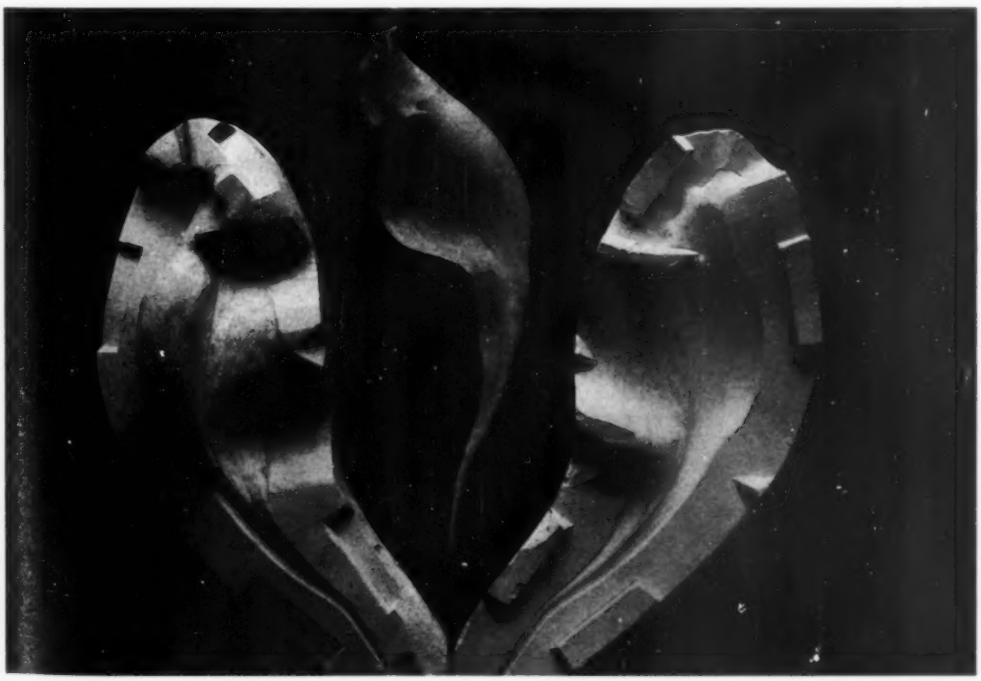


STEEL DISCS USED IN MAKING FLOWER PARTS

These discs cut the parts shown from waxed cloth, celluloid, or paper. Later they must be carefully assembled, moulded into form, and colored

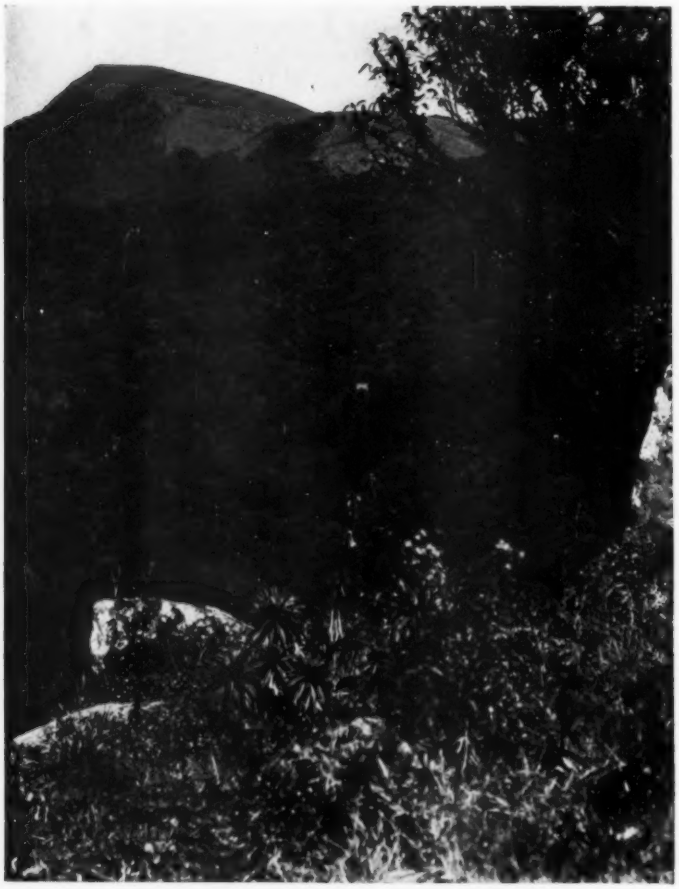
IN AN ACCESSORY LABORATORY

Members of the American Museum preparation department at work reproducing trees in wax. These trees will be installed in a new group for the African Hall



HOW A LEAF OF A PITCHER PLANT IS MADE

Carefully constructed of plaster, this two-part mold is used to form molten wax into accurate reproductions of one of Nature's most interesting plants



A PHOTOGRAPH TAKEN IN THE FIELD
From the plants shown in the foreground of this picture, the accessory workers have constructed details for a new Sambhur deer group

museum, it is thoroughly inspected to insure against any loss that might occur through a leaky container or disintegration of dry material. It is very important that dry material which is to be preserved should be put into solution as soon after arrival as possible. Formalin material will remain in good condition indefinitely and therefore can be used as needed. This is true even though there may be but little moisture left in the container; for this reason the bulk of the solution is drained from the cans before leaving the field base.

The leaf molds are made in the field only to insure against total loss in case a container springs a leak and the contents become too dry for use. The dry tree branches are immersed in hot water until relaxed and then are placed in a glycerine preserving solution which serves to retain the flexibility and permit reshaping. Molds are made from the extra leaves which were packed in solution for that purpose. The small grasses are transferred from the tank to the preserving bath, where they take up sufficient glycerine in a few hours to insure retaining their original fleshiness and quality. All preserved material must be recolored, since the color is destroyed in the process.

Several mediums are used in reproducing plants, and similar material, but the one generally used and accepted as most suitable is beeswax. A counter-mold is made from the mold which has been made of the surface of the leaf and this gives what is termed a "squeeze mold." Wire of sufficient strength to support the leaf is tapered by dipping it into nitric acid and then winding around it a thin film of cotton. This becomes the midrib of the leaf and the means for attaching it to the branch. The molds, mounted in a hinged clamp to insure perfect contact, are soaked with warm water to prevent the wax from sticking to the plaster, and a thin layer of cotton is placed over the counter-mold, with wire rib in place. A sufficient quantity of hot wax is poured over this

and the upper mold quickly clamped down. The wax congeals instantly with the contact, and the result is a wax impression of the original leaf. When this is trimmed and colored, it is difficult, at a very short distance, to detect any difference from the original. Flowers are built in much the same manner, but obviously are more complicated. It is sometimes necessary to resort to the use of celluloid or glass in order to secure the best results.

As I have suggested, a tree trunk may be successfully duplicated or rebuilt, and this is accomplished usually either by building in mache and wire netting, or by using the real bark over a wood form. So far as possible, the original branches are used, and the wax leaves, built into tips, on wire, are attached. Rocks are built by shaping wire mesh and covering it with burlap and plaster. The texture is obtained by various means and is largely a matter of careful study and ingenuity. The color is applied usually by spattering or by air brush, in a manner which suggests detail as well as color.

Finally, all of these parts are assembled and secured to a base, which becomes the groundwork of the group. This base is built up by placing uprights at intervals corresponding to the desired contour. It is then covered with heavy wire mesh, burlap, and plaster. The surfacing to represent ground is best accomplished by using a mixture of cement and dry color, with sifted ashes, thinned with water sufficiently to permit the real earth film to settle into it and become a part of it. Right here a group can be spoiled, for the natural appearance depends much upon the skilful handling of the silt and surface débris.

Though simple in detail, the Say's Ground Squirrel Group, in the Hall of North American Mammals, represents most of the ordinary accessory operations. The grasses, for instance, are glycerine-preserved and afterward colored; the several small plants of "Oregon grape" and the leaves of the quaking aspen are of

PLANTS FOR THE SAMBHUR DEER GROUP

These wild tobacco plants, constructed of wax, duplicate those shown in the foreground of the picture on the opposite page

STEPS IN GROUP CONSTRUCTION

This and the following three pictures are of the wolf group in the American Museum. The base form is built of wood, and is covered with wire screen and plaster

BUILDING TREES

In this case the natural bark is applied to an improvised wooden form. A mache composition, textured and colored to match the bark, is is used in "pointing up" the joined and broken portion

STEPS IN GROUP CONSTRUCTION

The ground is next covered with plaster, which is then sprayed with paraffine, thus creating "snow"

THE FINISHED GROUP

Three mounted wolves, surrounded by a painted background, plaster and paraffine "snow," and trees built up of real bark over artificial forms create an atmosphere of reality

wax, while the aspen shrub is the original and has been recolored after having been in preserving solution for several weeks. Woody parts take up the solution more slowly than grasses. The rocks have been shaped in wire mesh, burlap, and plaster, and the coarse granite texture has been obtained by mixing ground cork with the finishing coat of plaster. In this case, the color was spattered on to the surface with small hand scrub-brushes, as the texture and color of the granite suggested coarse spatterwork.

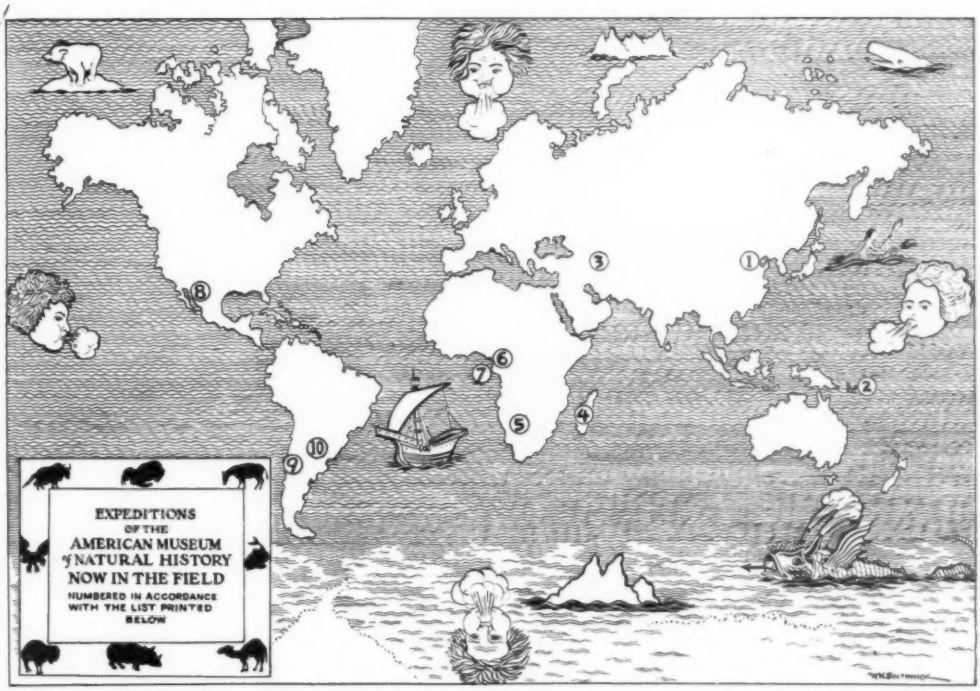
The ground effect has been obtained by applying to the base a plaster mixture of the color and tone of the actual ground and, while still wet, throwing the surface silt of granite shale, etc. into the mixture with sufficient force to insure its sticking. Rockwork made from molds of the original rock is sometimes utilized, thus reproducing Nature with the most faithful accuracy.

The accompanying pictures, showing how the base for the snow groundwork of the Wolf Group was built, present a good example of the method used, although this group was laid out more carefully than usual because of the necessity of having smooth, flowing lines for the drifted snow. In the same group two large tree trunks are shown. The bark for these was shipped to the Museum from the Colorado Rockies and, after having been treated with poison to kill any insect life which might be in it, it was applied to wooden forms as shown in the photographs. Another method of reproducing trees is shown in the Sphenodon Group in the Hall of Reptiles, at the American Museum. In this case a tree was modeled in mache over wire mesh from photographic studies of the original.

In short, the successful museum group is the product of close study, a sensitive feeling for truth, and technical ingenuity. The habitat group ranks high among the things which have done most to popularize the museum, and the part the "accessory" man plays in this important work has been little understood or appreciated.

MAKING LEAVES OF WAX AND COTTON

Mr. Butler, the author of this article, is here shown making a leaf in a "squeeze" mold. Often it is necessary to make these leaves by thousands



1.Central Asiatic; 2. Whitney South Sea, Solomon Islands, for birds; 3. Morden-Graves, Asiatic, for mammals; 4. Madagascar, for birds, mammals, and fossils; 5. Vernay, to Africa, for mammals; 6. Columbia University-American Museum, to Africa, for anatomical study; 7. Thorne-Correia, Gulf of Guinea, for birds; 8. Frick-Rak, New Mexico, for fossils; Frick-Falkenbach, Nebraska, for fossils; 9. Olson, South America, archæological reconnaissance; 10. Naumburg-Kaempfer, Southeastern Brazil, for birds

AMERICAN MUSEUM EXPEDITIONS

EDITED BY A. KATHERINE BERGER

It is the purpose of this department to keep readers of NATURAL HISTORY *informed as to the latest news of Museum expeditions in the field at the time the magazine goes to press. In many instances, however, the sources of information are so distant that it is not possible to include up-to-date data*

THE CENTRAL ASIATIC EXPEDITION.—A satisfactory adjustment has finally been effected between the Cultural Society and the Commission for the Preservation of Ancient Objects officially appointed by the government of Nanking, and the American Museum, making possible the continuation of the work of the Central Asiatic Expedition in Mongolia this season. Curator Walter Granger, chief palæontologist of the expedition, Mr. Albert Thomson, assistant in palæontology, and Mr. J. McKenzie Young, head of the motor transport, left New York early in April for Peiping by the quickest route, and the expedition was equipped and ready to start north into the Gobi Desert the first of May. This harmonious outcome of negotiations which have been in progress since August, 1928, will be extremely gratifying to geologists and palæontologists all over the world, and renews the coöperative relations between the American Museum and the scientific institutions of China.

THE OTTLEY-ANTHONY SOUTH AMERICAN EXPEDITION.—This expedition returned to New York on April 16, after a sojourn of six months in the field. The expedition was successful not only in securing a representation of the mammals from various localities, but more especially in carrying out reconnaissance over a very wide area, during which the party crossed the Andes no less than six times, and visited six of the South American republics. This expedition was made possible by the generosity of Mr. Gilbert Ottley, who acted as field assistant to Mr. H. E. Anthony, curator of the department of mammals at the American Museum, in charge of the expedition.

Messrs. Ottley and Anthony landed at Mollendo, Peru, in November, and after a short stop in Arequipa proceeded to Cuzco, and from there to Macchu Picchu, in the Urubamba valley. Here a collection of mammals was made, and the ancient ruins of Macchu Picchu were visited.

Returning to the main line railroad at Cuzco, the party traveled south to the shores of Lake Titicaca, where another camp was made just south of the lake and specimens of viscacha and other species of the high mountain fauna secured.

After crossing Lake Titicaca into Bolivia, headquarters were established at La Paz, and an important side trip was made to Sorata, where a pack train of mules was organized and a cross-section run from the high mountains down into the warm valleys, with camps at varying elevations. Upon the conclusion of the work in Bolivia, the expedition traveled by train from La Paz down through northwestern Argentina to Mendoza, where the Transandino or passenger train from Buenos Aires to Santiago could be boarded. At Puente del Inca, on the way to Santiago, the expedition stopped for a week in order to collect accessory material for Doctor Chapman's Aconcagua bird group. This group will show the South American condor against the background of Mt. Aconcagua, the highest of the South American peaks. A series of small mammals of the region was also secured at Puente del Inca, and on Christmas Day the party moved on to Santiago.

Here the necessary permits for collecting in Chile were obtained, after which the personnel proceeded by train to Angol, where transportation was secured for a side trip into the coast mountains of Nahuelbuta. Here a valuable collection was made in a forest of Araucaria, a conifer of ancient lineage, formerly of extensive range but found today in only a few restricted areas. Since this particular forest has been but little worked for mammals, it is quite possible that the expedition secured forms new to science there. In order to complete the observations on the Araucaria forest, the expedition moved from Angol to establish a second camp east of Curacautin in the main cordillera of the Andes, in the largest stand of Araucaria to be found in South America. At this place the collectors were also fortunate in securing some valuable small mammals. Traveling again by rail from Curacautin to Osorno, the party engaged automobiles and traveled around the western side of Lake Llanquihue, and meeting the railroad once more at Puerto Veras, proceeded to Puerto Montt, which is situated on Pacific waters. Puerto Montt served as a base for work lasting some weeks.

A small steamer was used to reach Puerto Aysen, about three hundred miles south of Puerto Montt, and by means of trucks and saddle animals, Messrs. Ottley and Anthony crossed the cordillera and arrived at Coyhaique, the headquarters of a great "estancia" comprising mroe than four hundred thousand acres which is given over to raising sheep. At Coyhaique, a camp was made in the forests of southern beech, and upon the conclusion of the work there everything was loaded into a big truck and the expedition traveled four days across the plains of Patagonia, a distance of 1250 kilometers, to Bariloche. This was a most interesting ride, during which there were good opportunities for observation of the wild life of the *pampa*, and great numbers of ducks and geese were seen, as well as guanaco, rhea, et cetera.

Bariloche is situated on the beautiful lake of Nahuel Huapi and is the Argentine terminus of the famous lake trip across into Chile. Traveling by boat, automobile, and mule, the party crossed successively Nahuel Huapi, Laguna Frias, the Chilean frontier, and the lakes of Todos Santos and Llanquihue, to arrive eventually at Puerto Montt once more. During this sojourn, camp was established on the lake of Todos Santos and small mammals were collected.

Once more, by steamer, the expedition moved south from Puerto Montt through the beautiful canals and inner waterways of Chile and through the Straits of Magellan to Punta Arenas, or, as it is now called, Magallanes, the southernmost city in the world. While awaiting steamer connections at Magallanes, Messrs. Ottley and Anthony hired an automobile and once more crossed the Andes, very low at this point, to Natales or Ultima Esperanza, which is situated on a long arm of the Pacific. At Natales they visited the famous cave of the Mylodon, where remains of the great ground sloth had been discovered, remains of the skin still retaining hair, and so fresh that many people believed that the animal was still to be found living in the wilderness of South America.

At Magallanes a steamer was secured for Buenos Aires, and en route north a number of short stops were made at practically all of the principal ports. In Buenos Aires the party stopped only long enough to arrange for steamer transportation and to visit the museum there and at La Plata near by. Ottley and Anthony then flew by airplane to Montevideo, a distance of 125 miles and about 70 minutes flying time. From Montevideo, after a short visit, they boarded the Royal Mail Steamer Almanzora for Rio de Janeiro. En route, the steamer stopped at Santos and the party had time to visit São Paulo by automobile and to make a trip to the snake farm at Butantan.

Arriving in Rio, there was time only for short trips about the city and to visit the museum there. The final and last move was by the

steamer "Western Prince," which sailed from Rio on April 2, and after a short stop at Bahia and Trinidad, came directly to New York.

The chief results of the expedition are a valuable collection of small mammals, extensive notes and data to be used in the identification of material now in the department of mammals and to serve as the background for future intensive collecting in southern South America, many photographs of topography and environment, and, finally, the establishment of personal contact with the principal museums in the regions visited.

THE BACON MINER EXPEDITION TO THE BAHAMAS.— Dr. and Mrs. Roy Waldo Miner recently returned from an expedition to the Bahamas where they spent the months of March and April. During the month of March, they were the guests of Mr. and Mrs. Daniel Bacon at their camp on Pirate's Nest, Long Cay, at the entrance to Nassau Harbor. During this part of the expedition, they were engaged in securing specimens of gorgonians for the Coral Reef Group which is being built for the American Museum in the Hall of Ocean Life under the direction of Doctor Miner. Mr. Junius Spencer Morgan, Jr., coöperated in making this expedition possible.

On April 1, Doctor Miner joined the International Expedition to Andros, which has been carried on there this spring under the direction of Dr. R. M. Field, professor of geology at Princeton University. Other members of this expedition were Dr. Charles J. Fish, director of the Buffalo Museum of Science, Professor Ulric Dahlgren of Princeton University, Mr. Maurice Black of Cambridge University, England, Dr. Ernest Dixon of the British Geological Survey, Dr. Werner Bavendamm of the Technische Hochschule of Dresden, Germany, and Lieut. Joseph P. Lushene of the U. S. Coast and Geodetic Survey. This phase of the expedition was devoted to making biological studies of the sponge banks on the west coast of Andros Island and obtaining geological data on the island itself. Doctor Miner, Doctor Dahlgren, and Doctor Fish coöperated in investigating the animal life of the sponge flats by means of trawling and dredging operations. The diving helmet was used here and on the east coast of Andros and also in the neighborhood of Nassau. Motion pictures were secured at depths ranging from two to three fathoms.

THE COLUMBIA UNIVERSITY–AMERICAN MUSEUM ANATOMICAL EXPEDITION.—Leader Harry C. Raven, who is still in West Africa, has sent the following letter to the American Museum:

DJAPOSTEN, FRENCH CAMEROUN
March 5, 1930.

Here it is March and I am still far in the interior of Africa with two gorillas unshot. And uncertainty as to when they can be met. Dr. Butler's cable, which we received in Yaunde, was definite enough in saying they would be disappointed if we returned without the West African gorillas and that leave of absence had been extended. They could not be more disappointed than I.

However, the time has gone so quickly that I now realize spring will be well on before I can get home. Gorillas, wandering about like primitive man, like also the pygmies living here in the forest now, have no fixed feeding or sleeping places. No one can tell where they will be at any given time. I have had several good native hunters here who have killed many gorillas, but they all say the same thing:—the dry season is no good for hunting gorillas. The rains have commenced, we have had a few showers but not enough to make the forest muddy. There should be plenty of rain soon. . . .

Almost the only meat readily available in the forest is monkey and I have eaten a good many and have saved the skulls of most of them. . . . There are remarkably few gorilla and chimpanzee skulls to be had. Most of the white men are on the lookout for them and of course the officials and missionaries get nearly everything, through the chiefs. Perfect skulls are very rare indeed because the natives lose the teeth and hack them with knives in getting off the precious meat. I am afraid they may even try to steal some of the embalmed gorilla if they get a chance, for they are ravenous for meat of any kind.

A few days ago a native brought me a variety of chamæleon, which we had not seen before. It has no horns but long neural spines like a miniature *Dimetrodon*. McGregor would have enjoyed it. I will try to get some pictures of it. My movie camera is not much good; it jams all the time.

H. C. RAVEN.

MORDEN–GRAVES EXPEDITION.—On March 23 cable messages were received from Siberia announcing that two fine males and one female specimen of the long-haired Siberian tiger have been obtained by the Morden–Graves Expedition in the wilds of the Amur River region in Eastern Siberia. An excellent group of these rare animals is now assured for the American Museum. A number of other mammals and birds have also been collected. A confirmatory letter addressed to President Osborn has been received just as NATURAL HISTORY goes to press, in which Mr. Morden says in part:

The three tigers which this Expedition has obtained are as follows: two large males, one female.

Our first two months in the field were spent about a hundred miles north of Khabarovsk, where local reports were that tigers were plentiful. We covered a great amount of territory, but were finally forced to the conclusion that there were very few tigers in that section. We therefore came back to Khabarovsk and made arrangements to work in the district between there and Vladivostok, where tigers were said to be more numerous.

A month in this latter district showed us that although there are undoubtedly more tigers there than north of Khabarovsk, the tigers are just as impossible to meet on foot as elsewhere, for the conditions of hunting are about the same. Mr. Graves did get on the day-old trail of one tiger, but found it quite impossible to come up with the animal. . . .

The three tigers which we have were killed, within a few miles of our camp, by gun-traps set out by local trappers, one of whom was our guide. We have sets of measurements, photographs of the animals before and after skinning, and, of course, the skins and complete skeletons. In addition, we have photographs and sufficient notes of the country to enable the department of preparation to construct a habitat group of these tigers. I feel therefore, that these specimens will make quite a complete group.

Mr. Goodwin has done excellent work in the collection of small mammals and birds, much of the time under great difficulties. The winter season, of course, is not the best for such collecting, and the specimens obtained by him do credit to his perseverance. . . .

The expedition planned to leave March 25 for Novosibirsk, from which a branch railway runs to Biisk, the portion of the Altai where Mr. Graves wished to hunt *Ovis ammon* and *Capra sibirica*. These plans had to be changed at the last moment, and the members of the expedition are now on their way back to America.

THE VERNAY-LANG KALAHARI EXPEDITION.—The latest reports from Mr. Arthur S. Vernay indicate most satisfactory results thus far, more than 200 mammals having been collected. In the Free State, groups of black wildebeest, blesbok, and springbok were secured, the springbok being quite different from those obtained by Mr. Vernay in Angola. The region never has been collected in before, save on the very edge, and hopes are high for very interesting results during the three months the expedition plans to remain in the field.

BEEBE-BARTON EXPEDITION TO NONESUCH ISLAND, BERMUDA.—William Beebe, director of the New York Zoological Society's Department of Tropical Research, left New York April 9 for Nonesuch Island in Bermuda to continue his researches begun in March, 1929, on the types of marine life from the surface of the sea down to a depth of about two miles. This is the first time a scientific group has explored the ocean depths vertically. Otis Barton, a member of the expedition, has invented and built a unique diving bell in the form of a sphere equipped with windows of fused quartz glass, through which the expedition members plan to study the life that exists at the various depths.

THE EIGHTH BERNHEIMER EXPEDITION.—The rugged and archæologically unknown Carrizo Mountain region in northeastern Arizona will be visited late in May and early in June by the Eighth Bernheimer Expedition. For this archæological reconnaissance, Mr. Charles L. Bernheimer, who leads and finances these expeditions, will be accompanied by Mr. Earl H. Morris, of the Carnegie Institution of Washington, which is coöperating with the American Museum in this undertaking.

PICTOGRAPH STUDY IN SOUTHWESTERN UNITED STATES.—The successful first season of study of the pictographs or rock paintings in Southwestern United States undertaken by Mrs. Ann Axtell Morris for the department of anthropology has led Mr. Charles L. Bernheimer, who initiated the project, to seek further financial support for its continuation. To this end there has been issued a small pamphlet describing the work of 1929 in Cañon del Muerto, Arizona, and reproducing some of the copies of these paintings by Mrs. Morris, the originals of which are on exhibition in the Museum. The American Museum is now able to announce that the investigation will continue for another year and it is expected that Mrs. Morris will visit and study those sites reported to have pictographs in southeastern Utah, in the vicinity of Carlsbad Cave in New Mexico, and between Farmington and Shiprock, as well as in Cañon del Muerto in Arizona.

THE BUSH NEGRO OF DUTCH GUIANA.—Dr. Morton C. Kahn, of the department of hygiene, Cornell University Medical College, who has made several journeys to Dutch Guiana to study the Bush Negro groups dwelling there, expects to return to Dutch Guiana this summer, as in the past, under the patronage of Mr. Myron I. Granger. The study of these Negro groups has been carried on with the coöperation of the department of anthropology of the American Museum, where Doctor Kahn has deposited his ethnological collections and the data on their culture. The forthcoming expedition will be to the Boni tribe of Bush Negroes living on the Tapanahony and Lawa rivers.

THE VINCENT ASTOR GALÁPAGOS EXPEDITION.—On May 2 a party of explorers and scientists returned to New York from a six weeks' cruise to the Galápagos Islands on Commodore Vincent Astor's yacht, "Nourmahal." The personnel of the expedition included Vincent Astor; Kermit Roosevelt; Dr. Eugene Pool, of the New York Hospital; Clarence L. Hay, of the American Museum; Dr. Charles H. Townsend, director of the New York Aquarium; Dr. James P. Chapin, of the American Museum; Dr. H. K. Svenson, of the Brooklyn Botanical Garden; Wilford A. Bronson; and E. R. Sanborn, of the New York Zoological Society. Doctor Townsend acted as scientific director of the expedition.

The island studied most thoroughly was Indefatigable, where the giant land tortoise, *Testudo porteri*, was the principal object of interest. No specimens had been seen for many years, but it was believed to survive, and several examples were among the prizes brought back. These will be sent to the tortoise colonies which Doctor Townsend has established in Arizona, Florida, and Texas.

Two hundred remarkably beautiful fish were kept alive throughout the homeward trip, and these are now on exhibition at the New York Aquarium. Besides iguanas of two species, a few penguins and flightless cormorants and some other birds characteristic of these strange islands were also secured for the New York Zoological Society.

Collections of insects, crustacea, land-shells and other mollusks, rodents, and birds were made for the American Museum of Natural History, while Doctor Svenson made a careful investigation of the flora, especially of Indefatigable Island. There, with Messrs. Roosevelt, Cutting, and Hay, he climbed to 2100 feet, and thus was able to make the first botanical collection from the higher and humid part of the island.

Other islands visited were Albemarle, Narborough, Charles, and Tower. No evidence of prehistoric occupation was discovered by Mr. Hay.

NOTES

ASTRONOMY

THE AMATEUR ASTRONOMERS ASSOCIATION broadcasted its last Saturday afternoon radio talk for the season on May 31. Mr. O. H. Caldwell, a member of the Federal Radio Commission, spoke on "Where the Orbits of Radio and Astronomy Meet." Station WOR has generously invited the Association to resume its broadcasts in the fall.

The regular meetings of the Amateur Astronomers Association, held on the first and third Wednesdays of each month, will be discontinued during the summer, as in the last two years. The fall reunion will take place on Wednesday evening, September 10, 1930.

BIRDS

A NEW MEMBER OF THE DEPARTMENT OF BIRDS.—The bird department of the American Museum has recently welcomed to its staff Mr. John T. Zimmer, who has been appointed to the position of associate curator of birds of the western hemisphere. Mr. Zimmer comes to the American Museum from the staff of the Field Museum of Chicago.

CONDOR COLLIDES WITH AIRPLANE AT 17,000 FEET.—The pilot of a commercial airplane route between Buenos Aires, Argentina, and Santiago, Chile, according to an interview published in the New York *Times*, reports that when crossing the Andes, at an elevation of 17,000 feet, his plane collided with and presumably killed a condor. Although there is no reason to doubt that this great vulture ascends to this, and even greater heights, it is interesting to have this belief confirmed by a definite observation.

The barometric pressure at an altitude of 17,000 feet is less than 16 inches, or about one-half of the atmospheric pressure at sea level. Nevertheless, the bird seems to fly under these conditions without undue exertion, and I have seen condors sailing over the slopes of Mt. Chimborazo in Ecuador, at 15,000 feet, with apparently as much ease as those observed in southern Patagonia at sea level.

Assuming that condors cannot become a menace to aerial navigation over the Andes, it is hoped that this incident may be interpreted as an evidence of their return to their normal abundance in a region where their numbers have been greatly reduced.

It was in September, 1916, when visiting the Natural History Museum in Mendoza, Argentina, that I was introduced by its director and founder, Carlos K. Reed, to an Italian named Pernando Porta, who had been a professional collector of condors. Chiefly through his own efforts as a trapper, but also by purchase from native hunters, he stated that he had secured in recent years 16,000 condors! Only the feathers of the wings and tail were preserved, and these were sold to milliners in Paris from whom he had received twenty dollars for the feathers of each bird.

At the time mentioned the price, due to the World War, had fallen to ten dollars per bird and, in a dramatic voice, the collector exclaimed, "I refuse to take part in the destruction of such a noble bird for such a low price."—F. M. C.

CONSERVATION

INTERNATIONAL WILD LIFE PROTECTION.—In recent years there has been an increasing interest in wild life conservation not only in this country but throughout the world. The danger to the very existence of certain animals particularly in Africa has been brought home to us by such people as Major Frederick R. Burnham, U. S. A. and Mr. C. W. Hobley on his recent visit to America on behalf of the British Society for the Preservation of the Fauna of the Empire. Mr. Madison Grant speaks of this in an excellent article in the March–April number of NATURAL HISTORY. As an illustration of our sympathy with the work the "Fauna Society" is doing, nearly ten thousand dollars was raised here in a

short time and put at their disposal for conservation purposes.

For a number of years there has been an International Office for Nature Protection established at Brussels by representatives of several continental nations under the auspices of the Union Internationale Des Sciences Biologiques. This office is increasing in importance day by day, but at present serves mainly as a library of information on all subjects of conservation, and has done much to interest foreign countries in establishing reserves and national parks modeled on some of our own. It has been supported in part by funds from private individuals in this country.

Already there are numerous American activities in international conservation. Among them for example is the important work that Dr. T. Gilbert Pearson, president of the National Association of Audubon Societies, has done toward organizing the International Committee for Bird Preservation. Professor Osborn, Dr. John C. Merriam, and Mrs. Mary L. Jobe Akeley, are members of the American Committee for the Parc National Albert in the Belgian Congo, Mr. E. D. Merrill, University of California, and Dr. P. S. Smith, U. S. Geological Survey, were appointed at the Fourth Pacific Science Congress in Java (May, 1923) as representative members for this country on a standing committee for the Protection of Nature In and Around the Pacific. Dr. Remington Kellog of the Smithsonian is representing the American Mammalogical Society at the April Congress in Berlin that has to do with Whale Conservation. From time to time a number of organizations and institutions in this country have sent resolutions with regard to the necessity for certain kinds of conservation by foreign governments—particularly with regard to legislation protecting animals found in their colonies that are fast becoming extinct.

Every day the sentiment for International Conservation is increasing in America, and individuals are asking how they can help this cause. There seems to be a great need for a central organization to represent this country in dealing with foreign nations and helping them if they ask for it on matters of wild life conservation. It is also important in some cases to subsidize certain existing agencies for the protection of animal, bird, and plant life before it is too late to save certain disappearing forms.

To meet this need an AMERICAN COMMITTEE FOR INTERNATIONAL WILD LIFE PROTECTION is being formed of representatives of the most important institutions and organizations in the United States particularly concerned with these matters. It is hoped that this committee will be given the strongest kind of backing by people in America interested in and wishing to support conservation in a world-wide application of its principles.

Any inquiries with respect to this committee should be sent to the Secretary of the Executive Committee.

The Executive Committee as appointed by Madison Grant, president of the Boone and Crockett Club, is made up as follows:

Dr. John C. Phillips, for the Boone and Crockett Club
Mr. George D. Pratt, for the American Museum of Natural History
Mr. Kermit Roosevelt, for the New York Zoological Society
Mr. Harold J. Coolidge, Jr., Secretary
Address—Museum of Comparative Zoology, Cambridge, Massachusetts

THE SOCIETY FOR THE PRESERVATION OF THE FAUNA OF THE BRITISH EMPIRE.—Contributions amounting to $9,550 have already been received from American subscribers to the Society for the Preservation of the Fauna of the British Empire, and have been transmitted by Madison Grant to Lord Onslow, president of the Society in London. The donors are:

Boone and Crockett Club (donated by Madison Grant)	$1,000
New York Zoological Society	2,000
American Museum of Natural History (donated by Daniel E. Pomeroy—$1,000; Childs Frick—$500; George D. Pratt—$500)	2,000
Mrs. Grace Rainey Rogers (in memory of the late Paul Rainey)	1,000
Field Museum of Natural History, Chicago (donated by Stanley Field)	1,000
American Nature Association (donated by Arthur N. Pack)	1,000
Henry W. DeForest, New York City	500
Herbert Hope, Philadelphia	50
The Wilderness Club of Philadelphia	1,000
Total	$9,550

It has been suggested that the subscribers be elected to suitable classes of membership in the Society for the Preservation of the Fauna of the Empire in order that their interest may be permanently retained. Also that the amounts subscribed be spent during the next two years for the purposes of the Society, instead of being held as a reserve fund.

Lord Onslow, in acknowledging the contributions, said that the Society had, during the last few weeks, arranged for an expert to proceed on a tour through the East African group of colonies to confer with the local governments and also with the growing communities of colonists, as the Society desires to induce a uniformity of policy regarding game preservation and to push forward the creation of permanent sanctuaries before it is too late. The Society is also hoping to take similar action in other parts of the world.

THE CHARLES SHELDON ANTELOPE REFUGE.—Through the activity of the National Association of Audubon Societies and the co-

operation of the Boone and Crockett Club, a sanctuary for the prong-horned antelope and the sage hen is to be established in northwestern Nevada. Mr. T. Gilbert Pearson, president of the Audubon Association, discovered territory exceptionally well suited for such a sanctuary in the summer of 1928, and at once took option for the Audubon Association on private holdings containing all the water holes within a radius of about a hundred square miles. Since then the Boone and Crockett Club has agreed to share half of the expense of $20,000 for acquiring additional territory, improving water holes, and building fences; and President Hoover withdrew from public entry much of the public property immediately surrounding these scattered holdings. Between five and six hundred acres still must be acquired from private owners. Altogether this will make an area of about 30,000 acres. It is reported that on this territory there exist from 800 to 2500 antelopes, according to the season of the year.

This sanctuary will be known as the Charles Sheldon Antelope Refuge, being named for the late Charles Sheldon, who was chairman of the Boone and Crockett Club's committee on conservation.

TO PROTECT THE BALD EAGLE.—The campaign which bird lovers have long been waging to prevent the possible extermination of the American eagle in the United States has been carried to Congress by the introduction of bills in the Senate and House providing a heavy fine for anyone that kills a bald eagle, "within the continental United States, Alaska, Porto Rico, or Hawaii."

This bill, which originated with the National Association of Audubon Societies, is sponsored in the Senate by Peter S. Norbeck of North Dakota and in the House by Congressman August H. Andresen of Minnesota, and has the endorsement of the National Committee on Wild-Life Legislation.

In a statement recently coming from the offices of the Audubon Society, Doctor Pearson says:

> The prejudice which has long existed on the part of the public generally, and Game Commissions particularly with respect to hawks and owls is well reflected in the legislation, or lack of legislation, pertaining to this class of birds. Careful researches have shown that most hawks and owls are more beneficial than harmful, although it has been exceedingly difficult to secure protection for them.
>
> One of the most picturesque and interesting of this group of birds, is the snowy owl, a few individuals of which migrate from the far North, each winter, into our northern tier of states. Occasionally, however, unusually large migrations occur, and at such times, these majestic birds are often killed in large numbers.
>
> The striking appearance, and the almost innocent demeanor of this owl, with respect to the ways of civilization, renders it an easy mark to that still considerable number of persons who like to shoot every large and unusual bird which comes their way.
>
> Careful studies of their food made during these periodic winter visitations have shown the snowy owl to be not destructive to any extent to game birds and animals and, therefore, deserving of complete protection.
>
> The National Association of Audubon Societies is endeavoring to secure the enactment of a law protecting hawks and owls in those States in which they are winter visitors, and where they are not now protected. Towards this end, efforts are being made in the re-codification of the Game Laws of Massachusetts and Rhode Island to place the snowy owl in the list of protected birds.

CONSERVATION OF RURAL SCENERY.—The New Jersey State Committee for Restriction of Outdoor Advertising is renewing the fight for legislation which was begun last year, and has reintroduced a bill for licensing and taxing billboards in New Jersey.

THE MAMMOTH CAVE NATIONAL PARK.—The governor of Kentucky recently signed a bill appropriating $1,500,000 for the purchase of lands around Mammoth Cave to be turned over to the Federal Government as a National Park.

EVERGLADES NATIONAL PARK.—Negotiations are under way for the establishment by the United States Government of a National Park in the Everglades of Florida to preserve for all time the remarkable deposits of fossil material and geological records that have not yet fallen under the advance of commercialism in that state. An exhaustive study of the entire region has recently been made by a committee who utilized a blimp in making the reconnaissance.

EDUCATION

FREE CULTURAL COURSES FOR TEACHERS.—For the season beginning October 21, 1930, and ending March 17, 1931, two special lecture courses will be available in the department of education at the American Museum, viz: (1) A Museum course in geography for teachers of the elementary schools, and (2) A Museum course for teachers in high schools and colleges.

The first, under the direction of Mrs. Grace Fisher Ramsey, associate curator of the department of education, is entitled "Man's Adjustment to His Environment," and is divided into three sections,

(1) Adjustment of Primitive Peoples
(2) Culture of Early Tribes and Nations
(3) Achievements of the Present

The second course, "Man and His Environment" will be under the direction of Dr. Clyde Fisher, curator of visual education, and will cover such subjects as astronomy, geology, palæontology, lower invertebrates, and insects. Each lecture period will be one and one-half hours in length, and will include both classroom discussions and laboratory work.

The laboratory work in the Museum's halls is such an integral part of each lecture period

that it has been found advisable to keep the numbers registering small enough to insure individual assistance in the study of special exhibits relating to the topic of each lecture. Therefore the registration in these courses is limited to one hundred teachers desiring the thirty hours' credit by the Board of Education. An additional three hundred teachers may register providing they wish to attend the lectures and carry on unsupervised laboratory work but do not desire official credit for the course. Registrations will be accepted in the order received and should be made before October 14, either by letter or in person, at the administration office, Room 306, School Service Building of the American Museum.

A third course of thirty lectures, "Backgrounds for Progressive School Units," has been planned by the American Museum in coöperation with the Metropolitan Museum of Art to meet the special needs of teachers of progressive schools, both public and private, who are carrying on experiments from which will develop new methods and material in education. The lectures will definitely correlate the rich resources of both museums with certain units now being worked out in schools of the newer type. Miss Marion E. Miller, instructor at the Metropolitan Museum, will present lectures covering present-day life and life in other days, and Dr. Margaret Mead, assistant curator of ethnology at the American Museum, will lecture on primitive life of North America. African, Australian, and Polynesian types will then be discussed and compared with the foregoing. This course begins October 2 and ends May 21. Thirty hours credit will be granted by the Board of Education, and two points credit by Teachers College if registration is made at the College.

Full information concerning any of these courses may be obtained from Dr. George H. Sherwood, curator-in-chief, department of public education, the American Museum of Natural History, 77th Street and Central Park West, New York City.

UNIVERSITY EXTENSION WORK AT THE AMERICAN MUSEUM.—During the past winter the American Museum has been offering, through Director George H. Sherwood, curator-in-chief of public education, special note-taking facilities on its unrivalled collections from all parts of the world, to highly qualified students in the following subjects: geology, mineralogy, biology, woods and forestry, zoölogy of the invertebrates, fishes, amphibians, reptiles, birds and mammals, and anthropology.

These facilities were extended in the morning hours when the Museum is comparatively free from visitors, and by special arrangement halls were partly closed off from the public.

MONTEFIORE HOSPITAL CRIPPLES VISIT THE AMERICAN MUSEUM.—April 21 was set apart by the American Museum especially for the entertainment of a group of cripples whose education is being provided by New York City in the annex of the Evander Childs High School at Montefiore Hospital. Large Museum auto trucks transported the group in their own wheel chairs from the hospital via the Speedway and Central Park to view the blossoming cherry trees and thence to the American Museum. After visiting the exhibition halls, the group was treated to a luncheon at the Museum by Mrs. Max Benswanger who is taking a keen interest in the work for the cripples. In the afternoon they were entertained with the motion picture "Nanook of the North," and then returned to the hospital by way of Riverside Drive, with a stop-over at the new Hudson River Bridge.

RECEPTION TO TRAINING SCHOOL GRADUATES.—On April 14 the department of public education of the American Museum tendered its semi-annual reception to the graduating class and the faculty of the Jamaica Training School for Teachers. The afternoon's program included brief talks on the Museum's School Service by Doctor Sherwood and Doctor Fisher, a tour of the School Service Building and some of the exhibition halls under the guidance of staff members, and concluded with a social hour in the North Bird Hall.

In June the graduating classes and the faculties of the New York Training School for Teachers and the Maxwell Training School will be entertained in the same way.

These receptions are planned to give the future teachers of Greater New York an opportunity to become acquainted with the American Museum and the facilities which it offers to the schools of the city.

MEMBERS DAY

ON April 16, the second annual visiting day for members of the American Museum, about four hundred and fifty members and their guests took advantage of the Museum's invitation to look behind the scenes and observe the great amount of work that goes into the preparation of groups and the research that follows expeditions.

Members of the Museum staff conducted the visitors through a number of the laboratories, through the preparation departments, and through the South Asiatic Hall which is not yet

open to the public. Readers of NATURAL HISTORY will be interested to know that a special exhibit for this occasion showed the processes involved in the making of NATURAL HISTORY MAGAZINE. Each step necessary in preparing an article for press, from the original manuscript and photographs to the finished product, was shown in concrete form. Original NATURAL HISTORY cover paintings formed a colorful background for this display.

Following the tour of inspection, the members assembled in Education Hall of the School Service Building, where tea was served. President Henry Fairfield Osborn then addressed the visitors on the increasing popular interest of the Museum.

HONORS

THE SPEYER MEMORIAL PRIZE.—At the 105th annual exhibition of the National Academy of Design, an ibex bronze by James L. Clark, assistant director in charge of preparation at the American Museum, was awarded the Speyer Memorial Prize for animal sculpture The inspiration for this statue came to Mr. Clark when, as a member of the famous Morden-Clark Asiatic Expedition of 1926–7, he collected a group of ibex in the Tian Shan Mountains of Central Asia. He was so impressed by the sturdy character of these animals and by their massive sweeping horns that he did not rest until he had reproduced one in bronze.

IBEX BRONZE
By James L. Clark
Winner of the Speyer Memorial Prize. The sculpture stands twelve inches high

Mr. Clark, who came to the American Museum in 1902 as an animal sculptor rather than as a taxidermist, received his art training in the Rhode Island School of Design and in the designing room of the Gorham Company. He has to his credit some fifteen pieces of animal sculpture in bronze, among which are an African black rhino with tick birds, which the late Colonel Roosevelt had on his library table at Oyster Bay, and a striking African buffalo, which was chosen by the African Big Game Club as their memorial to the great African hunter, F. C. Selous.

The American Museum is fortunate in having a sculptor of such high artistic standing leading its important work of preparation.

OTHER MUSEUMS

DEDICATION OF NEW MARINE ROOM AT PEABODY MUSEUM.—At the formal opening of the John Robinson Marine Hall in the Peabody Museum of Salem, Massachusetts, on the afternoon of February 22, 1930, the American Museum of Natural History was represented by Mr. John P. Benson and Dr. Robert Cushman Murphy. The former's close association with the American Museum began when he was commissioned to paint the murals of whales and whaling which decorate the Hall of Ocean Life. The first six lunettes of this series were presented to the Museum by Messrs. George T. Bowdoin, Junius Spencer Morgan, Jr., and Oliver G. Jennings. The seventh painting, representing a bowhead whale among Arctic ice-floes and bergs, is the gift to the Museum of the artist himself.

The Marine Room at Salem is dedicated to the memory of Mr. John Robinson, who had charge of the collections for the last twenty years of his life, and whose interest in that historical institution dates from his boyhood in Salem. The hall contains a large central case housing models of famous American ships, while elsewhere are paintings, chests, furniture, and other memorabilia of the days of Salem's maritime glory.

This collection comprises many portraits of prominent Salem merchants and master mariners; models of Salem vessels of the late Eighteenth and early Nineteenth centuries; another of the frigate "Constitution"—familiarly known as "Old Ironsides"—which was given to the Museum in 1813, by her captain, Isaac Hull, when fresh from his capture of the "Guerriere"; a large collection of paintings of Essex County vessels of the late Eighteenth and early Nineteenth centuries, including examples of the work of many local and foreign artists, especially of the Roux family of Marseilles; an extensive series of nautical instruments illustrating types used in navigation from the earliest to the most recent times; a representative collection of objects used

in the whaling industry; and a miscellaneous assortment of articles illustrating or associated with the life of a sailor before the mast.

Today this collection is one of the most important of its kind in the world, and the naming of this hall in honor of John Robinson is a fitting memorial.

MEETINGS OF SOCIETIES

THE SEVENTH INTERNATIONAL ORNITHOLOGICAL CONGRESS will be held at Amsterdam from June 1 to 7. Dr. Frank M. Chapman, curator-in-chief of the American Museum department of ornithology has been appointed to represent the American Museum officially at this Congress, and will present a paper on "The Origin of the Bird Life of Mounts Roraima and Duida."

THE AMERICAN ASSOCIATION OF ANATOMISTS.—The Forty-sixth Annual Meeting of the American Association of Anatomists was held, April 17-19, at the University of Virginia, Charlottesville, Virginia. Three papers were presented by members of the department of herpetology and experimental biology of the American Museum, two of them in the form of demonstrations. Doctor Noble and Miss Richards showed that a hormone of the pituitary gland at the base of the brain controlled the egg laying of salamanders. By transplanting the pituitary gland from one salamander to a female of the same species, the female was induced to lay its eggs in mid-winter. This discovery made it possible to obtain eggs from species whose life history was previously unknown.

Doctor Noble and Miss Richards also showed that the large perennibranch salamander, Siren, which spends its life in the swamps of Southern United States, undergoes a metamorphosis of its skin exactly like that of land salamanders. They were able to experimentally induce this metamorphosis in very young Siren, one or more years before the change would normally occur. Such experimental studies on the problem of metamorphosis throw considerable light on the origin of the large aquatic salamanders and the nature of the changes which make one species different from another.

Doctor Noble and Mr. Brady showed by demonstration that the hatching of the marbled salamander was controlled by secretions of unicellular hatching glands which are widely distributed over the snout of the larvæ for some time before hatching. Weak solutions of pilocarpine release the secretion and cause the larvæ to hatch at once. The marbled salamander lays its eggs on land and, if they are kept fairly dry, the hatching glands do not function and the larvæ may remain more than six months within the egg capsules.

THE UNIVERSITY OF ARIZONA INAUGURATES A NEW PRESIDENT.—The American Museum was officially represented by Dr. J. C. Merriam at the inauguration of Homer LeRoy Shantz as president of the University of Arizona, which took place on April 24.

THE AMERICAN ASSOCIATION OF MUSEUMS will hold its twenty-fifth annual meeting at Buffalo, June 4–7.

THE CONVENTION OF MAMMALOGISTS.—At the time this issue of NATURAL HISTORY goes to press plans for the annual convention of the American Society of Mammalogists are too incomplete for a detailed report. The sessions will be held in the American Museum of Natural History from May 21–24. It is planned to have a symposium on the gorilla, in which most of the American authorities on this animal will detail their views as to its relationships. There is also to be a symposium on "The Possibilities of Research in Zoological Parks."

Concurrent with this convention there is to be held in Education Hall of the Museum an exhibition of live-traps for animals, animal cages, exercising wheels, ultraviolet lamps, books, and related accessories for use of those studying living animals in the laboratory. This exhibit is contributed to by individual workers, research laboratories, and manufacturing concerns, to stimulate the study of animal behavior under laboratory conditions.

SCIENCE OF MAN

NATIVE LIFE IN NEW GUINEA.—A fine series of prints depicting interesting and unusual phases of native life in New Guinea has been presented to the American Museum by Mr. E. W. P. Chinnery, government anthropologist of the mandated territory of New Guinea. Mr. Chinnery, who is now visiting the department of anthropology, has lived for more than twenty years in New Guinea, on which subject he addressed the American Ethnological Society on Monday, April 28.

ESKIMO CARVINGS FROM ST. LAWRENCE ISLAND.—Modern survivals of the use of old techniques by primitive peoples always arouse special interest. There has come to the American Museum as a gift from Miss Vivian Zinn, a teacher in the school for Eskimo on St. Lawrence Island, a small series of ivory carvings made by these Eskimo. These carvings are good illustrations of the application of an old technique to a

newer use, for instead of being the old-time human and animal figures, these carvings are miniature reproductions of objects of White use and manufacture, perhaps the forerunners of the extinction of the whole carving technique. This collection contains also a waterproof *parka* or coat made from strips of seal intestine, such as is usually worn in the *umiak* or Eskimo skin boat. This particular coat is, however, designed for ceremonial use. Its chief interest lies in its construction in which may be observed some survivals of the ancient methods of skin-working prevalent in the Aleutian Islands many years ago, as demonstrated in the fragmentary skin clothing found in the burials at Fortress Island in the Aleutians by the Stoll-McCracken Expedition in 1928. In the Fortress Island examples, which are now being analyzed in the Museum, the garments have ornamental bands, consisting of very narrow strips of skin laid parallel to each other to form the width of the band. These narrow strips are sewn flat to the garment with tiny very regular stitches, and the bands are further enhanced by the introduction, at intervals, of colored strips of skin, or strips of skin with the hair adhering to it, forming a kind of fringe. One example has the beaks of birds with tufts of feathers attached at intervals to the skin strips. This ornamental motive finds an interesting parallel in the modern St. Lawrence Island coat which is reminiscent of the same general technique.

A PREHISTORIC INDIAN BURIAL.—The contents of the unusual tomb of a prehistoric Indian of Arizona, reported in a previous issue of NATURAL HISTORY, is now on exhibition in the hall for the Indians of the Southwest at the American Museum. This burial was in a cist in one of the caves of Cañon del Muerto, effectively sealed, the result being a remarkable preservation of all the mortuary offerings. The deceased was evidently a weaver of cotton, since hanks of warp, amounting to two miles of thread were found in the tomb. The probable date of the tomb is 1000 A. D.

NEW PUBLICATIONS

"On Some Recent New Light on the Origin of Mammals." By R. Broom. *Proc. Linnean Soc.* N.S.W., Vol. LIV, Part 5, 1929, pp. 688–694.

IN 1876 Sir Richard Owen, after describing the fossil "theriodont" reptiles from the Permian of South Africa, suggested that these forms may have given rise to the mammals "by secondary law, the mode of operation of which we have still to learn." In 1880 Huxley, neglecting the evidence cited by Owen and having in mind only the comparison of the anatomy of recent mammal and recent amphibians, taught that the mammalian class had been derived from the remote predecessors of the existing amphibians, the reptiles and birds being altogether off the line. The subject was discussed by Cope, Baur, Seeley, and other authorities, but it remained for Prof. Henry Fairfield Osborn in 1897 and 1898 to give the clearest exposition of the numerous mammal-like characters of the theriodont reptiles and to suggest that future discovery might well bring to light small forms of this group, containing the right combination of characters to be considered as the real ancestors of the mammals.

Since 1900 Dr. Robert Broom of South Africa has added enormously to our knowledge of these forms by discovering a multitude of new types varying in size from a rat to a hippopotamus, while he and Prof. D. M. S. Watson of London have led in the investigation of the entire problem of the origin of the mammals. A few weeks ago I received from Prof. Watson a photograph of one of his latest discoveries, a skeleton of a small "scaloposaurid" with especially mammalian characters in the limbs and certain very mammal-like features around the eye orbits; but not even this specimen was sufficiently advanced to be considered the true "missing link" between mammals and the mammal-like reptiles.

The latest discovery in this direction has been made by Dr. R. Broom, who has found in the Bloemfontein Museum in South Africa two fossil specimens which throw a flood of new light on the problem. These fossils come from the Upper Triassic red beds of South Africa.

The new animal is a small mammal-like creature about the size of a rat but with a relatively large head and a long tail. If the skull and lower jaw had been "made to order" they could not be a more perfect intermediate stage between the older "cynodonts" of the mammal-like series and the true mammals.

Thus Doctor Broom has set in place the capstone of his life work, which will be more fully described in his monograph on the entire group of mammal-like reptiles.—WILLIAM K. GREGORY.

Aquatic Mammals: Their Adaptations to Life in the Water. By A. Brazier Howell. Charles C. Thomas, Publisher. Springfield, Illinois; Baltimore, Maryland. 1930. viii + 338 pages. Frontispiece and 53 text figures.

THIS book, by a well known comparative anatomist of the Johns Hopkins University, may be safely recommended to any mature reader who happens to be interested in any one of the thousands of known facts concerning whales, sea cows, walruses, and other aquatic mammals. If we are curious to know how far down whales can dive, or how long they can resist the terrific

water pressure of great depths, or if we care to know what lies beneath that great smooth mass of blubber, there is no more authoritative and carefully tested body of information on the subject than is to be found in Doctor Howell's book. Or if we are surfeited and overwhelmed by the myriad facts of cetacean anatomy and desire some explanation, some even tentative interpretation, of the intricate anatomical mazes of the most highly specialized of all mammals, then we shall find here the material for many an enjoyable hour of reflection on some of Nature's greatest miracles.

To naturalists the subject of cetacean anatomy, for two centuries past one of the reliable staples of comparative anatomy, has received a new impetus from the broad and intensive investigations of Dr. Remington Kellogg of Washington on the anatomy and classification of recent and extinct whales. The author of this book, who gladly acknowledges the inspiration he has received both from Doctor Kellogg's publications and from frequent conferences with him, has likewise contributed greatly to lift the reproach from the science of comparative anatomy that it has in the past been too largely concerned with mere recording of facts and has failed to discover both how such a complex structure as the spermaceti organ of the sperm whale is used and by what steps it has attained its present complexity from more simple and understandable beginnings.

Not that Doctor Howell would make any claim to finality about the tentative theories, hypotheses, and explanations that he puts forward, or that have been advanced by others, to account for the astonishing facts of record. He constantly reminds us that we have taken only the initial steps, that only the corner of the veil of mystery has been lifted, that we must still feel our way further by means of tentative hypotheses which can be tested by future observation or experiment. Take, for instance, the simple question: how, exactly, does the sea-otte urse his large webbed hind feet in swimming? From those who have had the opportunity of observing the facts directly, Doctor Howell could learn little or nothing, even after a diligent correspondence. So he considers the several ways in which other web-footed mammals do use their limbs and then after most careful and penetrating analysis of the arrangement and relative strength of the bones and muscles of the pelvis and hind limbs of the sea-otter, he eliminates first one method of using the feet and then another; finally he makes the tentative inference that, in swimming, the sea-otter's feet are held horizontally to the rear, one on either side of the tail, with the sole up, and that they are oscillated in the vertical plane on the same principle on which the whale uses its flukes.

After prolonged analyses of the anatomy of the whales and porpoises, he concludes that "there seems to be considerable evidence that the Cetacea could most readily and quickly have evolved from some sort of terrestrial ancestor having many of the chief bodily characteristics now occurring in the sea-otter." This of course does not imply any real relationship with the sea-otter, and Doctor Kellogg seems to incline to the opinion that the remote terrestrial ancestors of the whales were small insectivorous mammals of the Cretaceous epoch.—W. K. G.

OBSERVATIONS AND EXPERIMENTS IN INSECT LIFE.—Two of the technical papers recently published by the department of insect life at the American Museum are of popular interest. One concerns **Observations on Leaf-cutting Ants** (*Novitates*, No. 388) by F. E. Lutz and the other is **An Analysis of a Movitone Record of a Cricket's Chirp** (*Novitates*, No. 420), by F. E. Lutz and W. R. Hicks.

While at the Barro Colorado Laboratory in the Panama Canal Zone, Doctor Lutz noticed a natural "set up" for studying the burden-bearing activities of those interesting ants that cut pieces of leaves and carry them to the colony's nest for the purpose of growing on them the fungus food of the colony. Their trail was over a liana affording a variety of grades ranging from steep-down, through level, to steep-up. What effect has grade on the speed with which burdens are carried? Are the large ants more efficient than the small ones? Very small members of the colony are much given to stealing rides on the burdens carried by their larger sisters. What effect has this amusing habit on the economy of the colony? What is the signal for starting and stopping work? These are some of the questions which are discussed by means of tabulated observations that cannot conveniently be reproduced here. The object back of these studies was to gather evidence on the complicated problem as to whether insects really think or whether they are mere machines entirely governed by the laws of physics and chemistry. Although the author avoids a direct commitment, it is easy to see that he inclines toward the first of these alternatives.

The other paper grew out of a Fox Movietone Company film recording the chirping of a cricket. The cheerful males of these creatures produce their music by rubbing a "file" on one front wing against a "scraper" on the other. Sound, as we hear it, is a series of rapid vibrations of air

affecting our auditory machinery. The more vibrations per second the higher is the pitch of the sound. As shown in this paper by a greatly enlarged photograph of the film, each sound vibration is represented by a line across the film's "sound-track." Knowing the speed at which the film goes through the camera and measuring under a microscope the distance between these sound lines enabled Doctor Lutz and Mr. Hicks to discover several interesting things about the chirping of our common black cricket. For example, what sounds to us like a single chirp is usually three chirps which they call "pulses." Each pulse lasts for about 0.02 second and the pulses of a chirp are separated by a quiet interval of about 0.017 second, too short an interval for our ears to notice. Usually, at least under the conditions of this experiment, each pulse starts at about the D which is just above the upper limit of a piano, rises a bit in pitch, maintains that note, and then suddenly drops nearly a full note to almost within piano range. Such a performance would, in musical terms, be called a beautifully executed "slur." The authors also give pictures of the recording apparatus and of the cricket's musical instrument.

RECENT ACCESSIONS

NEW ACCESSIONS OF IMPORTANCE.—For some time members of the scientific staff of the American Museum have needed for their use the Hispanic American section of the Millionth Map of the World, published by the American Geographical Society. This map will consist eventually of about 100 sheets, of which all published so far have now been procured by the Museum Library, the others to follow as issued. It is gratifying to know that this most up-to-date and important map is now available.

The Library also received this month the first volume of the *Encyclopædia of the Social Sciences.* This ought to prove valuable for the many students in anthropology who use the Library, as well as for our own department in that subject. The scope of the work seems to be broad, and it will doubtless prove useful in showing the relationships between anthropology and the related sciences.

Among the additions to our serials during February are the *Annales de Géologie et de Paléontologie,* Volumes 1–51, 1886–1929, twenty additional volumes of the *Edinburgh New Philosophical Journal, 1833-1854, Bollettino dei Musei di Zoologia e Anatomia Comparata della R. Universitá di Genova,* Volumes 2–5, 1895–1905, and *Atti del R. Accademia dei Lincei* 1882–1886.

A MEMORIAL TO STEPHEN H. TYNG.—The photographic equipment of the American Museum recently has been enriched by a most important gift from Mrs. Stephen H. Tyng, presented in memory of her husband. Through this splendid contribution the Museum comes into possession of many pieces of valuable lighting equipment and photographic apparatus, including a De Brie Professional Moving Picture Camera, a Bell and Howell Eyemo, and a studio camera with a complement of four 11×14 portrait lenses beautifully inscribed in memory of Mr. Tyng.

Mr. Stephen H. Tyng, F. R. P. S., was one of the noted amateur photographers of the Camera Club and the Royal Photographic Society of Great Britain. To establish and endow a school offering practical help to those interested in the art of photography was a cherished desire of his, and it seems particularly fitting that his splendid equipment should be given to the American Museum to aid in its educational work.

SOME "NATURAL HISTORY" CONTRIBUTORS

Henry Clyde Shetrone, author of "The Mound Builders" is a veteran of the Spanish American War, with service in Cuba, where, following the war, he was for three years superintendent of telegraph for the Cuban government. His opportunity to engage in archæological and museum work came in 1913, as assistant curator of archæology under the late Dr. William C. Mills, director of the Ohio State Museum. On the death of Doctor Mills, in 1928, he succeeded to the post of director.

Mr. Shetrone has conducted explorations of the prehistoric mounds of Ohio for the past fifteen years, and is considered one of the foremost authorities on this branch of American archæology. In addition to his official reports of explorations, and frequent contributions to magazines, he is the author of a volume entitled *The Indian in Ohio,* and an exhaustive work, *The Mound Builders,* just off the press of D. Appleton and Company. *The Mound Builders* covers the entire mound area, embracing more than twenty states, and combines human interest with scientific accuracy. The illustrations in the NATURAL HISTORY article are from this book.

Since his student days at Harvard, from which college he was graduated and received the degree of Ph.D., **Dr. H. L. Shapiro** has been interested in the origin and distribution of races and physical types, especially in race mixture. Shortly after joining the staff of the American Museum as assistant curator of physical anthropology, Doctor Shapiro visited Santo Domingo and the southwest of the United States where he did archæological work and looked for skeletal material. The trip described in "The Disappearing Peoples of the South Seas" was Doctor Shapiro's second to Polynesia, the first one being to Pitcairn and Norfolk Islands, as a Yale fellow and for the Bishop Museum of Honolulu. He is leaving New York again in July to take charge of a race-mixture study program for the University of Hawaii.

Doctor Shapiro has recently published a monograph on the descendants of the mutineers of the "Bounty," dealing with the Polynesian-English cross.

Lieut. G. T. Emmons, U.S.N., the author of "The Art of the Northwest Coast Indians," has long been an authority on the Indians of the North Pacific Coast of America. He first became interested in their ethnology while in the Navy, from which he is now retired. For more than forty years he has continued his active interest in collecting information and ethnological material from these people, and the comprehensive collections in the American Museum illustrating the North Pacific Coast cultures are largely due to his unflagging efforts and interest.

He has published many papers on various phases of their culture, some of which have appeared in NATURAL HISTORY,

and has in preparation an important contribution on the Tlingit.

Marcelle Roigneau (**Hatt**) was born at Bordeaux, France. After coming to America to live, she took special courses at Columbia University in vertebrate zoölogy, evolution of man, and vertebrate palæontology with Profs. J. H. McGregor and William K. Gregory, who both rated her high among their students. In the department of comparative anatomy at the American Museum she is chiefly engaged in planning the installation of the series of exhibits for the Introduction to Human and Comparative Anatomy. "'Top of the World' in Yucatan" describes some of her experiences in a recent American Museum expedition.

THE COVER

"The Woolly Mammoth of the North," the cover design of this issue by **Arthur A. Jansson**, represents a summer dawn scene in northern Indiana during the period of maximum southward advance of the fourth or Wisconsin glaciation, the final attempt of the ice kings of the North to invade the United States. The three woolly mammoth bulls are browsing and grazing upon the grassy and arboreal verdure, filling their storage reservoirs of fat for the coming winter, as is indicated in their projecting foreheads. The woolly undercoating has not yet attained its autumnal or winter thickness. The shiny ivory tusks are in three stages of growth, the nearest being that of an elderly bull

NEW MEMBERS

SINCE the last issue of NATURAL HISTORY, the following persons have been elected members of the American Museum, making the total membership 12,000.

Patrons

Mrs. STEPHEN H. TYNG.

Messrs. JOHN P. BENSON, MORRIS LEGENDRE, SIDNEY LEGENDRE.

Life Members

Mesdames OTTO GERDAU, AMORY L. HASKELL, PARIS PHILIPS, NELSON B. SACKETT.

Misses ALICE E. KINGSBURY, E. B. SCRIPPS.

Messrs. HUBERT K. DALTON, JOS. L. LILIENTHAL, SCHUYLER A. OAKS, LUDWIG VOGELSTEIN, DWIGHT DEERE WIMAN.

Sustaining Members

Mesdames E. FARRAR BATESON, EDWIN H. BROWN, LEOPOLD FREDRICK, ARTHUR L. KERRIGAN, R. A. DELIMA MAYER, BYRON D. MILLER.

Misses CLARA CUDAHY, HELEN E. DAVIS.

Doctors HARLOW BROOKS, LOUIS HAUSWIRTH.

Rear Adm. WILLARD H. BROWNSON.

Messrs. ELMER T. BUTLER, H. DURANT CHEEVER, WM. NELSON DAVEY, MARTIN J. GILLEN, ERNEST K. HALBACH, GEORGE FREDERICK HANDEL, W. DE F. HAYNES, CHARLES S. KEENE, ARTHUR H. KEHOE, EDWARD KOHNSTAMM, ETHELBERT IDE LOW, GEORGE LUEDERS, PHILIP A. MOSMAN, SAMUEL PEARSALL, HUGH S. ROBERTSON, MEYER STERN, MYER L. VICTORIUS, ROSS YOUNG.

Annual Members

Mesdames BRUCE BARTON, ARTHUR S. BELL, WALLER BORDEN, EDWIN N. CHAPMAN, HOWARD FIELD CHAPPELL, W. J. CHILDS, H. E. DECKER, PERCY L. DOUGLAS, ELLSWORTH ELIOT, H. A. FORTINGTON, RICHARD GAMBRILL, CHARLES E. GOODHUE, JOHN GRIBBEL, SAMUEL HOFF, CALVERT HOLT, ALFRED F. LOOMIS, OLNEY B. MAIRS, W. LAWRENCE MCLANE, CHARLES E. MITCHELL, JOHN L. MORGENTHAU, CHARLES A. MORSS, SAMUEL T. PETERS, SAMUEL F. PRYOR, JR., HENRY RICE PUTNAM, EVA RICH, E. B. ROSENHEIM, ROBERT J. F. SCHWARZENBACH, GEORGE W. SELIGMAN, JOYCE SHONNARD, ELMER J. SNOW, WILLIAM C. SPRUANCE, J. ERNEST STERN, RALPH H. THOMPSON, ARTHUR TRAIN, AUGUSTUS VAN CORTLANDT, J. T. WALLER, BULKELEY L. WELLS.

Misses RACHAEL BEAM, LAURETTA CAMPBELL, CONSTANCE CUTLER, RUTH DRAPER, S. B. FAY, MAUDE FISHER, MABEL FREUDENVOLL, MARIE E. GYGI, LEORA HOUGHTON, A. KNEELAND, JEAN B. NICOLL, CLARA OLTMANN, MARY C. PAGE, LYDIA S. PIQUET, E. L. PLATT, MARION H. POLLAK, DOROTHY L. RATTERMAN, GERTRUDE WHITING.

Reverend WILLIAM S. HUBBELL.

Doctors HENRY S. FENIMORE COOPER, NELSON C. DAVIS, BERNARD S. DENZER, ALBERT F. GRIFFITHS, LLEWELLYN E. HETRICK, MARVIN F. JONES, EUGENE KLEIN, MARSHALL WM. MCDUFFIE, RANDLE C. ROSENBERGER, WILSON G. WOOD.

Col. L. A. WATRES.

Messrs. V. S. ANDREW, HARRY W. ATKINSON, SHERMAN BALDWIN, ROY BARNETT, WALTER BECK, LAWRENCE BERENSON, HERBERT L. BOCKSTAHLER, RANDAL BOROUGH, WILLIAM H. BRADY, ALFRED H. BROOKS, EDWARD F. BRUNDAGE, CHAS. LIVINGSTON BULL, GUY I. BURCH, GEORGE W. BURPEE, ALLSTON BURR, A. J. BUTTREY, CLIFFORD CARVER, JOHN A. COLEMAN, JR., SAMUEL S. COOLEY, J. GEORGE COSTELLO, M. J. DELEHANTY, PAUL O. DRURY, JOSEPH H. DURRELL, JAMES P. EADIE, E. R. EASTON, JR., JOSEPH D. EDDY, REUBEN EPRO, LEO S. FRANKEL, ARNOLD FRYE, EGBERT C. FULLER, JOHN PALMER GAVIT, JAY C. GUGGENHEIMER, ERNEST HARRAH, EARL W. HARRINGTON, WM. HOWARD HART, ALAN R. HAWLEY, T. PIERREPONT HAZARD, JOSEPH H. HEIL, MILO B. HILLEGAS, FRANCKLYN HOGEBOOM, M. G. HOLSTEIN, VICTOR HUGO, WILLIAM F. HUNT, MALCOLM DUBOIS HUNTER, EDWARD A. HURD, H. HERBERT JOHNSON, SIDNEY JOHNSON, JR., JOHN JONAS, JOSEPH P. KASPER, HARRY E. KNIGHT, ARTHUR KROCK, H. ALFRED LANGBEN, CLIFFORD M. LEONARD, J. E. LOPEZ, MAURICE A. MEUNIER, WALTER E. MEYER, J. L. NEUSCHELLER, L. W. NEUSTADTER, RAYMOND G. NOBLE, C. S. W. PACKARD, CHARLES L. PEET, WM. S. POST, THOMAS J. POWERS, JR., JOHN A. POYNTON, ROBERT KELLY PRENTICE. LEON M. PRINCE, JOHN REQUARDT, WILLIAM FRANCIS RUSSELL, NORMAN SCHAFF, CHAS. K. SEYMOUR, WILLIAM M. SIGAL, SIDNEY P. SIMPSON, J. STERLING B. SMITH, F. SPARRE, C. H. SPRAGUE, HORACE N. STEVENS, WILLIAM STONE, JR., HENRY F. TIEDEMANN, LOUIS B. TIM, FRANK F. VANDERHOEF, FREDERICK R. VAN VECHTEN, FREDERICK H. WAPPLER, LAURENCE D. WEAVER, E. CANTELO WHITE, H. LE ROY WHITNEY, PERCIVAL WILDS, ROGER B. WILLIAMS, RICHARD P. WINDISCH, ROBERT B. WOLF, ROY V. WRIGHT, BLINN F. YATES, LEONARD A. YERKES, JOHN E. ZIMMERMANN.

Associate Members

Mesdames H. F. BALDWIN, LILLIAN B. BIRTWISTLE, S. H. CARR, JULIA PATTERSON CRANE, RUBY E. B. DORT, GEORGE E. GAGE, KATHRINE GOULD, WHITNEY HARB, MASSEY HOLMES, D. G. HOPKINS, GEORGIOS KOSMOPOULOS, G. Y. MCCLURE, PAUL JENNINGS NOWLAND, J. H. REED, FRANK H. SHAFFER, MARY UNWIN.

Misses MILDRED BENNETT, ANNA W. CUTLER, CATHERINE DENT, MARY DEWING, EUNICE W. DEXTER, MARGARET E. DREWETT, NORMA E. FURTOS, HARRIET HEYDRICK, MARY ESTHER HUGER, CAROLINE A. HUGHITT, ANNA CLARK JONES, CORA B. MORRIS, VIRGINIA NEWCOMER, KATE P. PERIN, AMELIA L. SCHLEICHER, MARJORY TAYLOR, M. LOUISE TRIEBNER, HELEN WEIHER, ELLA C. WINSELL.

Reverend JOHN A. KEARNEY.

Doctors BROOKS BELL, IRA D. CARDIFF, ROBERT JOSEPH DIVEN, ARTHUR T. FOWLER, H. H. HAMMEL, IRA C. HARMAN, ANDREW D. HOPKINS, JAMES W. INCHES, B. H. JACKSON, J. T. KELLY, JR., WM. C. MCKECHNIE, L. G. REDDING, HAROLD O. RUH, RAYMOND W. RUNYON, SAMUEL R. SKILLERN, JR., EDWARD H. TAYLOR, WILFRED TAYLOR.

Messrs. J. B. ABBOTT, ARTHUR ADAMS, JACK SCOTT ADKINS, C. G. ALDRICH, FRANK W. ALDRICH, J. ALGERNON BADGER, WARWICK BENEDICT, W. D. BENSON, A. S. BERTOLET, W. CHANNING BLANCHARD, J. N. BOSE, HARRY A. BREMER, W. E. BRIGGS, FRANK D. BURGESS, EDWIN A. BURLINGAME, EDWARD BUTLER, FELIX R. CALDWELL, F. J. CARR, JAMES M. CASSADY, JUAN BAUTISTA CASTRILLÓN, JOHN PATRICK CRANGLE, RALPH F. CUSHMAN, E. E. DAVIS, L. DELEGLISE, ARTHUR P. DRURY, JAMES W. DWYER, DAN P. EELLS, WM. NEWBOLD ELY, FRANCIS GAYNOR EVANS, STEPHEN FAIRBANKS, JOHN FAIRCHILD, MULFORD B. FOSTER, ELMER E. FRITCHEY, THOS. GERRARD, T. N. GILL, JR., S. R. GINSBURG, W. L. GOLDSBOROUGH, J. O. GULEKE, JNO. H. HAYMAKER, MAX HENRICI, JOHN HERMAN, MARLAND C. HOBBS, VAN HORNBECK, R. P. HUTCHINSON, YASUSHI IBARA, A. H. ISENBERG, CHARLES HERBERT NEWTON JACKSON, J. L. KALB, T. S. KEYES, WILLIAM BRETT KIEFFER, LE ROY KING, JR., DONALD LANE, G. M. LESTER, WILLARD DEMING LEWIS, THOMAS H. MAY, A. MACKENZIE MELDRUM, WILDER S. METCALF, OLIVER MILLARD, FORREST W. MILLER, D. W. MOREHOUSE, C. E. MORGAN, 3D., CLARKE HARTON MORIAN, GEORGE BURGESS NEWMAN, CLAUDE NORRIS, J. E. PATTERSON, GEORGE B. PEARCE, JOHN W. PERKINS, RICHARD H. POUGH, HENRY B. PROUT, W. D. QACKENBUSH, JOHN A. RENSHAW, ELRIC ROBINSON, GUY A. RONDOT, CHARLES F. ROSICA, ELBERT B. RUTH, ROSS R. SCOTT, ROY SCOTT, JOSEPH C. SPELLERBERG, R. R. SQUIRE, WALTER STAGER, WENDELL O. STEWART, FRANK S. STONE, ROYAL C. TAFT, KATUYA TAGO, B. THAW, J. LOUIS TROEMNER, ERWIN WACHTLER, CECIL WARD, EZRA J. WARNER, WILLIAM C. WATERS, ROBERT T. WELCH, GUY R. WILLIAMS, SIDNEY WILSON, FRANK WOOD.